
Aunt Lydia's Cove, Chatham, Massachusetts

Supplemental Information Report

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SUPPLEMENTAL INFORMATION REPORT

1. GENERAL ASSUMPTIONS

a. Assumption: Fishery management plans to restore and maintain the groundfish stocks will be put into effect in the Northeast. The plans will most likely limit the overall regional fishing catch.

Rationale: The New England Fisheries Management Council and the National Marine Fisheries Service have a mandate to complete regional fishery management plans by the end of 1992.

Documentation: The New England Fisheries Management Council, the National Marine Fisheries (NMFS) and the fishing industry recognize that fishing effort must be restricted to rebuild the ground fish stocks. Amendment #5 to the Northeast Multispecies Plan was designed to accomplish this goal. Under this amendment days at sea spent fishing would be reduced by 10% a year for the next five years. The provisions of Amendment #5 can be found in Appendix 1.

The Conservation Law Foundation (CLF) and The Massachusetts Audubon Society initiated a lawsuit in June 28, 1991 against NMFS and the Secretary of Commerce for failing to prevent overfishing of cod, haddock and yellow tail flounder. A consent decree agreed upon on August 28, 1991 required a timetable for the development of Amendment #5 to the Multispecies Fishery Management Plan. According to the consent decree the New England Council was to have submitted its final groundfish rebuilding plan to the Secretary of Commerce by September 1, 1992. If this deadline was not met, NMFS was then to have prepared a program to eliminate overfishing. This plan was to have been made public by November 1, 1992. Neither of these deadlines were met. Thus NMFS is officially in non-compliance with the consent decree. Despite the legal confusion and lack of agreement on the appropriate measures to control effort, it seems likely that some sort of fishery regulation will be imposed to reduce the mortality of groundfish.

b. Assumption: The Chatham fleet will not be encumbered by any currently proposed fishery management plans. Additional plans could limit fishing effort (days) in Aunt Lydia's Cove but, to no significant effect.

Rationale: Because most gillnetters fish fewer than 100 nets and the hook gear vessels fish fewer than 4,500 hooks per day, currently proposed fishery management plans will have little effect on fishing effort at Aunt Lydia's Cove. The major impact is likely to be on gillnetters who have to convert to 8" or larger mesh size.

Documentation: Amendment #5, described in Appendix 1, indicates that there are separate rules for gillnetters and hook fishermen, which comprise the majority of the Aunt Lydia's Cove fishing fleet. Gillnetter vessels that use 8" or larger mesh exclusively and hook gear vessels with less than 4500 hooks per day would not be restricted in their fishing effort.

c. Assumption: In the with-project condition, the landings at Chatham should increase to historic levels.

Rationale: Based on conversations with NMFS the level of catch at Chatham can be projected to increase to historic (1980-1990) levels and remain relatively constant thereafter barring any unforeseen decline in stock caused by natural or other outside forces.

Documentation: Despite the decline in cod stocks, the Aunt Lydia's Cove fleet has been able to maintain their catch as can be seen with reference to the table below. As shown in the second column of the table, Cod stocks increased in the George's Bank area following the expulsion of the foreign fleet in 1977. However this trend came to an end in 1983, when overfishing by the US fleet caused cod stocks to decline. Landings at the Fish Pier show the same increase from 1977 peaking in the three years from 1979 to 1981. Since then landings have declined, but have remained fairly consistent. There was an increase in the 1987 to 1989 period with landings returning to the 1982 to 1986 period level in 1990 and then declining in 1991 and 1992.

Cod abundance does have an effect on the Aunt Lydia's Cove landings. Regressing pounds of ground fish landed at the Fish Pier against cod landings for the Northeast indicates that an increase of one thousand metric tons in landings for the Northeast will result in increased landings at the fish pier by approximately 96,300 pounds. This coefficient is statistically significant. However, the equation explains only 29 percent of the variations in landings at the fish pier. Thus, 71 percent of the variation in landings is explained by factors other than the general abundance of the species. The equation and associated statistics is shown below the table. In addition, NMFS has assessed the ability of the Aunt Lydia's Cove fleet to maintain their catch level. Their assessment indicates that the Aunt Lydia's fleet should be able to maintain historic catch levels. This assessment is addressed in a letter from NMFS dated June 12, 1992 (see Appendix 2).

History of
Ground Fish Landings

<u>Year</u>	<u>George's Banks</u> <u>Commercial Cod Landings</u> <u>(Metric Tons)</u>	<u>Aunt Lydia's Cove</u> <u>Fish Landings</u> <u>(Pounds)</u>
1975	25,008	5,446,125
1976	19,926	4,108,500
1977	27,367	3,178,000
1978	35,357	5,562,500
1979	38,623	8,180,625
1980	48,116	9,604,375
1981	42,348	8,500,625
1982	57,157	7,243,500
1983	48,886	5,877,250
1984	38,678	7,249,000
1985	37,271	7,304,000
1986	25,901	6,962,500
1987	30,880	8,280,750
1988	39,242	7,531,750
1989	33,098	8,186,625
1990	42,503	7,208,375
1991	37,630	5,655,250
1992	28,100	4,525,125

Regression Output:

Constant	3,187,500
Std Err of Y Est	1,476,737
R Squared	0.288
No. of Observations	18
Degrees of Freedom	16

Pier Landings Coefficient	96.3
Std Err of Coeff	37.9

d. Assumption: In the without-project condition, landings at Chatham will decrease based on the reduction in time available at the fishing grounds as a result of delays due to insufficient depths at all stages of the tide. This situation will continue until such time as it becomes more efficient to retire the existing vessels and replace them with shallower draft vessels, move to other locations, or go out of business rather than continue to bear the inefficiencies of tidal delays.

Rationale: Without dredging, the harbor will be inaccessible for most of the fleet at low water. Fishermen will alter their operations to maximize their time at the fishing grounds. They will either depart early to avoid low water conditions or will delay departure until after low water. On the return trip, they will schedule their arrival in order to off load the catch in time for shipment to market in New York for the following morning. In either circumstance, inefficiencies are experienced. Fishermen will continue to bear these inefficiencies until such time as it becomes more economical to retire their existing vessel and replace it with a shallower draft vessel, move to other locations, or go out of business. For many practical reasons it is unlikely that there will be a significant shift to smaller boats or a significant relocation of vessels to other ports. Safety and cost considerations mitigate against a shift to shallower draft vessels and greater distance and costs of getting to the fishing grounds mitigate against relocation. Also, a shift to shallower draft vessels would make future exploitation of non-traditional species more difficult. These are generally low valued species requiring high volumes to make exploitation a viable alternative. In any event, landings at Chatham will be reduced based on reduced time available to spend at the fishing grounds. The estimate of the amount of reduction in landings to Chatham and specification of the without condition requires input from the fishermen and fish buyers.

Documentation: In the without project condition landings will decline from those currently existing. Vessels in some cases will have to curtail fishing trips to avoid delays or in some cases will not fish at all as there would not be enough time at the fishing grounds to make the trip productive. Reduced fishing effort will lead to fewer landings initially but the long term impact is more difficult to quantify.

It is very difficult to establish the relationship between effort and landings with a species that is harvested beyond the point of maximum sustainable yield (MSY) such as cod. Fishermen reported that shoaling in the channel would reduce their fishing effort by 529 days for all trips, and 464 days for groundfish trips. Again, based on information supplied by fishermen, average groundfish catch per trip is 1880 lbs (consistent with the report in Appendix 3). With one trip per day, the total landings reduction is estimated to be approximately 873,000 lbs. This estimation of reduced landings assumes that catch per unit of effort is constant. If this were to increase in the without project condition, then the reduction in landings at Aunt Lydia's Cove would be overstated. Thus the decrease in catch would not be proportionate to the decrease in fishing effort. In fact, in the case with a species that is harvested beyond the point of MSY the catch per unit of effort may increase to the extent that the total catch is greater with the reduction in effort. Also, from an NED

perspective fish landings lost at Aunt Lydia's Cove may be offset by increased landings of fishermen from other ports that fish the same grounds.

e. Assumption: Existing fleet at other Northeast ports are underutilized.

Rationale: Because of the overdevelopment of the fishing fleet in the Northeast and the reduced catch experienced during the past 15 years, existing fleets at ports nearby to Chatham may be able to catch the quantities of fish which would be lost to the Chatham fleet in the without project condition. On the other hand, the Chatham fleet fish an area generally not fished from other ports and consequently the resource may not be fully exploited in the without condition.

Documentation: Excess capacity exists in the New England groundfish industry. As reported by the National Marine Fisheries (NMFS) Atlantic Cod catch declined from 57,157 metric tons in 1982 to 37,630 metric tons in 1991, a decline of approximately 34%. NMFS also reported that the number of fishing vessels in the New England otter trawl fleet declined from 988 in 1982 to 822 in 1991, a decline of approximately 17%.

2. WITHOUT PROJECT DEPTH

Evaluate alternative plans based on two different assumptions regarding controlling water depths in the without project condition; zero-feet and minus one-foot mean low water. If the NED plans formulated under either scenario are significantly different, provide an explicit discussion of the basis for selecting the proper without project controlling depth.

Discussion: The economic analysis appears to be quite sensitive to the assumption of the controlling depth in the without project condition. The Corps representative at the meeting stated that the minus one-foot controlling depth used was the historic low water. The sponsor indicated that shoaling will be greater because the Corps had not taken into account that the harbor was dredged to prevent more shoaling. Had the dredging not occurred, the sponsor believes shoaling would have continued.

Input: The draft Detailed Project Report currently evaluates benefits with the most likely without project depth of 1-foot below mean low water (MLW). The project benefit is \$353,000. If the without project depth in the spar channel was 0-feet at MLW then the project benefit is estimated to be \$466,700.

As discussed in the Coastal Engineering Research Center report (1989) and NED's draft report (1991) there is no certainty which can be assigned to future conditions in this very dynamic physical setting. The 1-foot of depth at MLW is based on a hydrographic survey from January 1991. The survey reflected conditions in the channel over a year after the town last dredged (fall of 1989) and after considerable shoaling had occurred. No one knows with certainty what the without project depth will be in the future. In absence of that knowledge, depths experienced in the recent past during a period of heavy shoaling were used as the basis for the value assigned to the without project condition. NED does not conclude that a different without project depth, say 0-feet at MLW, could be used. However, NED does believe that a without project depth assumption of 1-foot below MLW is reasonable in light of the following information.

Physical conditions in the area reveal that there is a hydraulic tendency to maintain some form of drainage channel passing south between Tern Island and the shoreline on the outgoing tide. Aerial photography, taken when there was no dredged channel into Aunt Lydia's Cove (1938), shows the existence of a very shallow natural channel. Where and how deep this drainage channel would be in the future without dredging is subject to the constantly shifting shoals and changing shoreline in the area. However, the existence of 1-foot of water at MLW is reasonable given the hydraulic requirement to exchange water through this portion of the cove and harbor. This exchange is expected to continue in the future as long as water is allowed to pass from north of Tern Island and down its west side. A more accurate prediction of future depths in the cove area would require extensive monitoring and hydraulic modeling of Chatham Harbor.

Since the 1-foot below MLW condition was recorded, several dredgings of the spar channel have taken place. As a result of this continuing effort to maintain a navigable channel, the controlling depth in the spar channel has not been shallower than 2 to 3-feet below MLW. Periodic maintenance of the channel provides a without project depth greater than the 1-foot below MLW assumption. The town has indicated that once existing funds are exhausted, their efforts will cease, and the channel will fill in.

Since the analysis for the draft Detailed Project Report was done, new information regarding an alternative dredging source has been provided that could also affect the assumed without project depth. Letters provided by the Massachusetts Coastal Zone Management Office dated March 27, 1992 and by the Massachusetts Department of Environmental Management dated August 18, 1992 and April 20, 1993 (see Appendix 2) indicate that the state is establishing a County Dredge Program for Barnstable County. The program involves the capital outlay for purchase of a dredge and subsidized maintenance of navigation projects in the Cape Cod area. The dredge equipment is anticipated to be available some time in 1993. The letter from MDEM also states that the dredge "could only be considered for one project at Aunt Lydia's Cove annually". The availability of this equipment to dredge in Chatham on an annual basis would be the basis for a without project depth greater than that discussed above. A without project depth of 3-feet below MLW would not be an unreasonable assumption. Conservatively assuming the without project depth of the spar

channel is 3-feet below MLW, the benefits associated with a Federal project would be \$128,300 annually based on the original analysis contained in the draft Detailed Project Report.

3. RELOCATION OF VESSELS FROM AUNT LYDIA'S COVE

Determine and provide supporting data and discussion regarding potential relocation of vessels away from Chatham.

Discussion: Significant relocation of vessels away from Chatham is unlikely. In the project report, the division assumed 21 boats would be relocated to Stage Harbor. At the meeting, the harbormaster said that Stage Harbor could not accommodate more than just a few additional vessels. The harbor moorings are fully allocated and there is a waiting list of 65 applications for moorings. During the past year, 12 vessels relocated from Chatham to State Harbor due to inadequate depths at Chatham. However, the harbormaster stated that the availability of moorings at Stage Harbor was due to a temporary downturn in use of moorings by people who have mooring permits. This downturn is attributed to the general recent decline in economic vitality in the region. As economic activity increases and over the long term, these mooring spaces would not normally be available.

Input: Of the 21 ground fish boats expected to relocate to Stage Harbor in the without project condition of the Detailed Project Report, it is likely that 11 have or would be willing to do so and 8 vessels would go out of business (one has since retired and one was mistakenly listed as a deep draft vessel). Additionally, one lobster boat is also likely to transfer to Stage Harbor. This represents the upper limit of vessels that could relocate to Stage Harbor (see Appendix 3).

4. WITHOUT PROJECT ALTERNATIVES FOR THE FLEET

For those fishermen not able to relocate their vessels to Stage Harbor, provide an analysis with supporting data and rationale of whether they would go out of business, move to a more distant harbor, continue to operate their existing vessels, or convert to shallower draft vessels.

Input: In the without project condition it is likely that fishing effort will be reduced and although landings in the region will remain the same, landings at Aunt Lydia's Cove may actually decline. The Detailed Project Report assumed that fresh fish not supplied by fishermen from Aunt Lydia's Cove would be supplied by other fishermen resulting in a transfer, or regional benefit, and not an NED benefit. After additional investigation it was determined that there was an incremental premium (above fresh fish) being paid at the dock for Chatham fish. This increment is due to the unique quality of the Chatham cod. In Appendix 3 an estimate of revenue loss is derived for those fishermen that are likely to transfer operations to Stage Harbor. This same methodology was applied to the vessels that are likely to continue fishing out of Aunt Lydia's Cove in the without project condition. For the remaining 49 fishermen left at Aunt Lydia's Cove, including lobstermen, it is likely that all 49 will continue to fish out of Aunt Lydia's Cove.

(1) Based on the assumption that the total catch in the region remains the same in the with- and without-project conditions, three categories of benefits will be computed, as applicable, for these alternatives.

(a) Additional total water and land transportation costs to market required to land the Chatham catch at the nearest alternative fishing port. Determine origin/destination cost from best available source.

Input: The additional total water and land transportation costs to market required to land the Chatham catch at the nearest port could not be determined. Fish not harvested at Chatham presumably would be harvested by vessels from a number of regional ports including New Bedford, Provincetown, Hyannis, Scituate and Portsmouth, NH. It would be entirely speculative to allocate the lost Chatham catch to these ports. Additionally, once landed the fish would be sent to different markets. Thus a cost analysis would not be meaningful (see Appendix 3).

(b) Revenue lost due to the "freshness factor". When including the freshness factor, provide documentation to confirm that fish landed at Chatham actually bring a higher price to the fishermen at dock side than fish landed elsewhere in the Northeast. Also, the methodology will need to be reviewed with packing house representatives and others knowledgeable in the industry to ensure that the conclusions are sound.

Input: The ex-vessel price paid to Chatham fishermen for fresh fish will be higher with access to the New York market. If the access were reduced then revenues for Chatham fishermen will decline. This decline would be offset by increased revenues of other suppliers of fresh fish to the New York market. This would be considered a regional transfer and not an economic loss. However, payments to other fishermen would be less than the loss of revenue to the Chatham fishermen. The difference can be attributed to the quality of fresh Chatham cod. Revenue loss due to the "freshness factor" for Chatham cod has been estimated to be between \$0.025 and \$0.175 per pound (see Appendix 3).

The 8 vessels that would not be able to fish out of Aunt Lydia's Cove and that would go out of business account for an estimated 1,335,400 pounds of landings. If their entire catch received the premium, the revenue loss would range between \$33,385 and \$233,695 with a midpoint of \$133,500. This would represent an upper bound. A lower bound estimate is developed assuming one half the catch receives the premium price. Lost revenue would then be between \$16,700 and \$116,800 with a midpoint estimate of \$66,800. The midpoint of the two midpoints would then be \$100,150.

For the 11 vessels that would be able to fish out of Stage Harbor, upper and lower bounds were developed to measure the loss in revenue premium. The upper bound assumes that all fish caught out of ALC receive the freshness premium and that one half of these fish will not receive the premium when landed at Stage Harbor. It is also assumed that these fish

receive \$0.175 per pound, the upper bound used to estimate the freshness premium. The lower bound assumes that one half the fish landed by these fishermen at ALC receive the freshness premium and that ten percent of these fish would lose the premium. The lower bound estimate also assumes the lower bound ex-vessel premium for Chatham fish of \$0.025.

Using these assumptions and the fish catch of these 11 fishermen of 1,774,300 pounds results in a range of lost revenue premium of between \$2,200 and \$155,100 with a midpoint estimate of \$78,700.

Although the analysis above was based on interviews with 19 of the 21 vessels that were identified in the draft Detailed Project Report as relocating to Stage Harbor, it seems reasonable to assume that in determining the "freshness" premium loss that similar assumptions could be made for the fishermen remaining at ALC. As in Stage Harbor, losses are based upon catch. Total groundfish catch at ALC in the without project condition is estimated to be 4,098,700 pounds. This catch estimate is arrived at by subtracting the catch attributed to the 19 boats analyzed above (3,109,700 pounds) from the 1990 total groundfish catch at ALC of 7,208,400 pounds. Annual fish landings per boat is estimated to be 91,100 pounds.

For vessels that would likely continue to fish from Aunt Lydia's Cove similar assumptions are made as with those that continued to fish in the without project condition from Stage Harbor. For the upper bound one half the catch is assumed to receive the premium price and the premium loss is measured at \$0.175 per pound. This upper limit is estimated to be \$358,600. The lower limit assumes again that one half the catch would receive the premium price and that 10% lose freshness. The premium loss is measured at \$0.025 per pound. The lower limit or freshness loss is estimated to be \$5,100. The midpoint between the two limits is \$181,900.

In summary, freshness premium loss in the without project condition is estimated as follows:

Vessels fishing out of Stage Harbor	\$ 78,700
Vessels fishing out of ALC	\$181,900
Vessels going out of business	\$100,200.

The preceding analysis draws heavily on the report contained in Appendix 3. It assumes that the catch per unit of effort remains the same over time and catch per unit of effort may rise as overall effort is diminished. Thus, these potential benefits must be used cautiously.

(c) Loss of use of vessels which would be subject to early retirement and replacement by shallow draft vessels due to lack of depth in the harbor.

Discussion: At the meeting, fishermen stated that the Chatham catch is essentially all delivered to the New York Fulton fish market daily. Chatham is a day-fishery with all catch being brought to port every day by virtue of its close proximity to the fishing grounds. In this way, buyers

are assured of the freshest possible catch which in turn brings a higher price than fish landed at other ports more distant from the fishing grounds and usually held in holds of fishing vessels for several days. In addition, fishermen stated they would be reluctant to convert to shallow draft vessels because of investments in their existing vessels. If they are forced to convert prematurely, there would be a loss of part of their existing investment. The vessels involved could not be used at other ports because of their size and cruising range. This assumption should be evaluated and rationale provided regarding whether it is valid or not.

Input: There were not any fishermen that indicated in interviews that they would replace their vessels with shallow draft vessels due to a lack of depth in the harbor. Reducing vessel size could pose an additional safety risk in the open ocean.

(2) Benefits for these categories are determined as follows.

(a) For those fishermen who would go out of business, categories 4(1)(a) and 4(1)(b) above should be calculated.

Input: For those fishermen that would relocate outside of Chatham or go out of business, reduced freshness benefit would be \$100,200. There are no additional measurable transportation and water cost needed to market the catch.

(b) For those fishermen who move to another harbor, NED losses should be calculated for added transportation costs and reduced freshness advantage.

Input: For those fishermen who moved to Stage Harbor freshness premium loss is estimated to be \$78,700. There would be no additional transportation cost needed to market the fish catch.

(c) For those fishermen who would continue to operate their existing vessels, NED losses are measured by the transportation and freshness losses attributable to their reduced catch.

Input: For those fishermen that would continue to operate out of ALC freshness premium loss is estimated to be \$181,900. There are no additional transportation costs attributable to the reduced catch.

(d) For those fishermen who convert to shallower draft vessels, NED losses are measured for all three categories and reflect the timing of the conversion to shallow draft vessels.

Input: There were no additional benefits from the reduction in conversion costs to shallower draft vessels.

5. TERN ISLAND DISPOSAL SITE

Evaluate the potential for use of Tern Island for disposal of dredged material and include an analysis showing the effect on project justification of using Tern Island. The evaluation should include any cost savings to the Audubon Society for material placement as a benefit to the extent that such costs can be documented.

Discussion: At the meeting it was said that several years of maintenance dredging could be placed on the island without any significant impact to the intertidal zone. Other statements made at the meeting implied that the amount that could be placed on the island was very limited. The facts and probabilities for use of the island need to be clearly sorted out.

Input: As discussed in the draft Detailed Project Report, initial construction quantities were to be placed in either a confined disposal facility (CDF) or loosely placed on Tern Island. The use of the CDF is not considered an acceptable solution to the Massachusetts Audubon Society, the group overseeing the island's continued use as a coastal bird habitat. However, they do support the loose placement of dredge material on certain areas of the island. Therefore, initial construction quantities were estimated to be disposed of, in loose fashion, on Tern Island. Maintenance activities were estimated to involve disposal in the area of Lighthouse Beach, over a mile from the project site.

Since the breach in 1987, the town of Chatham has conducted three maintenance dredging operations in Aunt Lydia's Cove. In 1989, 7,000 cy of sand was removed, in 1991, 34,850 cy of sand was removed, and in 1992, 4,400 cy of sand was removed (refer to Appendix 2). Another maintenance operation is currently underway, with an estimated 30,000 to 40,000 cy of material being removed (the entire anchorage and channel dredged to 7-feet below MLW with 1-foot of allowable overdepth). In each case where dredging was done, the method of disposal was loose placement on Tern Island.

Letters from the Massachusetts Audubon Society, dated February 10, 1992 and March 4, 1993, state their requirements for disposal on the island (see Appendix 2). In summary, they state that disposal can take place on two different areas of the island. The material can be placed, loosely, up to an elevation of 20-feet above MLW (15-feet above MHW). Once nesting waterbirds have become reestablished, any disposal activities would be limited to the period of time from September 10 through March 10, with the possible addition of one month before and after these dates. Raising of the disposal ceiling in the future will be considered only to the extent that it "will not damage the nesting populations of birds at that time".

In February 1993, a topographic survey was conducted of the disposal areas on Tern Island (see Appendix 4). This was done to determine just how much material could be placed on the island, based on the 20-feet above MLW ceiling. The survey revealed that there are about 18 acres of surface area available for dredge material disposal. Using 1 on 4 sideslopes, it was determined that there is currently 270,000 cy of

additional space for disposal. The 1 on 4 sideslope assumes some form of final grading of the disposal mound. Factoring in an estimated 40,000 cy of material being placed on the island this spring by the town of Chatham, 230,000 cy of space would remain available for future disposal. Factoring in the placement of about 86,000 cy of material for the initial construction of a Federal project, this would leave about 144,000 cy of space available for future Federal maintenance of the project. Based on the estimated annual maintenance quantity of 21,400 cy, there would be about 7 years of maintenance capacity on the island ($144,000 \text{ cy} / 21,400 \text{ cy/yr} = 6.75 \text{ yr}$). This does not include any renourishment needs that may arise in the future.

As a result of this information, long term (50-year project life) use of Tern Island as a disposal site is limited. This is why an alternative long term site, such as the Lighthouse Beach area, was included in the annual maintenance estimates of the Detailed Project Report. A list of the various maintenance scenarios and their associated annual costs for disposal in the Lighthouse Beach area is shown in chapter 8.

The costs associated with disposal on Tern Island, for the first 7 years of a project, are shown in the following table.

Annual Maintenance Cost
Plan B - Channel South of Tern Island
 (Maintenance Disposal at Tern Island)

Maintenance 3X/year	\$444,000
Maintenance 2X/year	\$321,000
Maintenance 1X/year	\$211,000

The following 43 years of the project would entail maintenance disposal at Lighthouse Beach. The costs associated with that, shown in chapter 8, would be discounted along with the figures just presented to arrive at the total annual maintenance cost of the project. The annualized initial construction cost, with disposal on Tern Island, (\$44,000 for the 8-foot channel, \$32,000 for the 6-foot channel, and \$23,000 for the 4-foot channel), is added to the discounted annual maintenance cost to arrive at the total annual cost.

Total Annual Cost
Plan B - Channel South of Tern Island
 (Maintenance Disposal at Tern Island - 7 Years
 & Lighthouse Beach - 43 Years)

	<u>8-Foot Channel</u>	<u>6-Foot Channel</u>	<u>4-Foot Channel</u>
Maintenance 3X/year	\$590,000	\$578,000	\$569,000
Maintenance 2X/year	\$431,000	\$419,000	\$410,000
Maintenance 1X/year	\$308,000	\$296,000	\$287,000

If initial construction disposal were to take place on Lighthouse Beach instead of Tern Island, then an additional 4 years of maintenance material could be placed on Tern Island. This would result in an 11 year disposal capacity for Tern Island. The annualized initial construction cost, with disposal on Lighthouse Beach, (\$56,000 for the 8-foot channel, \$41,000 for the 6-foot channel, and \$26,000 for the 4-foot channel) is added to the discounted annual maintenance cost to arrive at the total annual cost.

Total Annual Cost
Plan B - Channel South of Tern Island
 (Maintenance Disposal at Tern Island - 11 Years
 & Lighthouse Beach - 39 Years)

	<u>8-Foot Channel</u>	<u>6-Foot Channel</u>	<u>4-Foot Channel</u>
Maintenance 3X/year	\$573,000	\$558,000	\$543,000
Maintenance 2X/year	\$425,000	\$410,000	\$395,000
Maintenance 1X/year	\$305,000	\$290,000	\$275,000

Another alternative considered, placement of maintenance material in a 4-acre intertidal and subtidal area on the north side of Tern Island, was also proposed by the Audubon Society. The advantage of using this area for disposal is that dredging costs could be kept lower, as opposed to going to Lighthouse Beach, for a longer period of time.

The capacity of the intertidal area north of Tern Island is estimated to be as follows:

$$43560 \text{ sqft/acre} \times 18 \text{ ft}/27 = 29,000 \text{ cy/acre}$$

Factoring in sideslopes, the capacity of this area is on the order of 100,000 cy. The capacity of the intertidal area would last for about five years ($100,000 \text{ cy}/21,400 \text{ cy/yr} = 4.7 \text{ yr}$).

The disposal of any dredged material in the intertidal zone would need to be approved by local, State and Federal permits. Based on 404 (b) (1) guidelines and other State/local regulations, disposal would require a thorough analysis that no other practicable alternative exists to the filling of intertidal areas. Disposal in intertidal areas, especially special aquatic sites, is discouraged as it can cause or contribute to the significant degradation of waters. Approval of such a plan is, therefore, speculative.

Even if approvals could be secured there would be required mitigation. At this time, estimates for such mitigation total about \$60,000 per acre. This would result in an annual cost for the 4 acre area of \$20,000 per year.

Finally, a similar incremental analysis, for a channel north of Tern Island, Plan C, was not developed for this analysis or for those in chapters 7 or 8, for several reasons. There has never been a navigation channel in this area and, therefore, there is no firm data on shoaling rates. Furthermore, studies to date reveal that, for environmental reasons, any plan to dredge in this area would in all probability not be approved.

6. THRESHOLD LEVEL FOR FISH LANDINGS

Determine whether there is a minimum threshold level of fish landings required to keep the shoreside facilities in operation. If this is true, provide appropriate documentation to support the determination.

Discussion: At the meeting, the sponsor stated that without some minimum level of fish catch, operation of the shoreside facilities would become uneconomical and would not be available to land the catch. This would affect the assumption regarding the landings in the without project condition.

Input: The Chatham Fish Pier is currently operated by lease to Chatham Fish and Lobster Company and Chatham's Finest. Currently these two buyers divide the fish pier landings approximately in half. The managers of each establishment had difficulty determining the threshold level of landings that would be needed to make the packing operation profitable. However, it is possible to derive a reasonable estimate. One of the buyers indicated that his operating costs were approximately \$154,000 annually. Reducing labor costs to a minimum, this cost could be lowered to \$122,400. Thus the increase in price received by the buyers must cover this cost. Using \$1 per pound as the price paid to fishermen, on average, then dividing the annual cost of \$122,400 by 0.18 will yield the value of landings needed to cover costs. The 18% mark-up was taken from a previous study of the fishing industry in Chatham. This computation will yield \$680,000, or pounds of fish, needed to be landed annually per buyer at the pier. Given the uncertainties in deriving this number, 700,000 pounds seems to be a reasonable estimate of the landings per buyer needed to operate a packing operation at the pier.

It should be pointed out that even if the processing of fish is no longer profitable at the pier, fish could still be landed there. The off loading equipment would still be in place. Given the high value of the fish landed it seems reasonable to assume that they would find their way to market. The landing of fish and the packing of fish are two separate processes and need not be one combined operation, as they are at the fish pier. Indeed this is the case in almost all other fishing ports in New England.

7. DREDGING SENSITIVITY ANALYSIS

Include an analysis of an alternative plan which provides dredging the full project depth to be available at the beginning of the prime fishing season. Continue the analysis of required dredging on an as needed basis. This would essentially be an incremental analysis based on time as the increment. Include data to confirm the distribution of landings throughout the year.

Discussion: At the meeting, fishermen stated that 75 percent of the annual catch is landed in a three or four month period beginning in June each year. If that is so, most of the project benefits can be attributable to the dredging event immediately preceding that time. This could yield an NED plan which provides for dredging only during the time of year it is most needed.

Input: Landings at the Fish Pier in Aunt Lydia's Cove, for the months June through September, for the last ten years (1980 to 1990), have averaged 60% of total landings. During the other eight months of the year, about 40% of the total catch is landed. Assuming the channel is dredged to project depth by May of each year and the channel shoals in at a rate of 6 inches per month, an incremental analysis of the amount of dredging done each year yields the following results. Due to the limiting features of the breach (6-feet deep at MLW) and the draft of the vessels, once the channel shoals to a point where the depth is less than 4-feet at MLW, benefits begin to decrease. The following benefit analyses are based on a without project depth in the spar channel of 1-foot below MLW. This first table summarizes benefits based on the analysis presented in the draft Detailed Project Report.

Total Annual Benefits
Plan B - Channel South of Tern Island
 (Based on 1/3 Manufacturing Wage Rate)

	<u>8-Foot Channel</u>	<u>6-Foot Channel</u>	<u>4-Foot Channel</u>
Maintenance 3X/year (every 4 months)	\$353,000	\$353,000	\$250,000
Maintenance 2X/year (every 6 months)	\$353,000	\$342,000	\$179,000
Maintenance 1X/year (every 12 months)	\$319,000	\$211,000	\$102,000

Applying the full manufacturing wage rate in the same benefit calculations yields the following results.

Total Annual Benefits
Plan B - Channel South of Tern Island
 (Based on Full Manufacturing Wage Rate)

	<u>8-Foot Channel</u>	<u>6-Foot Channel</u>	<u>4-Foot Channel</u>
Maintenance 3X/year (every 4 months)	\$678,000	\$678,000	\$514,000
Maintenance 2X/year (every 6 months)	\$678,000	\$662,000	\$354,000
Maintenance 1X/year (every 12 months)	\$623,000	\$407,000	\$190,000

8. ADVANCED MAINTENANCE DREDGING

Analyze whether there are any cost reductions which may be gained from a program of advanced maintenance dredging.

Discussion: This subject was brought up at the meeting with the idea that a cost savings could be realized by reducing the number of times dredging would have to take place in a year.

Input: As shown in the draft Detailed Project Report and the preceding analysis, there is no difference in the maximum achievable benefits when dredging from 6-feet to 8-feet below MLW in Aunt Lydia's Cove. This is due to the limiting 6-foot depth of the breach. An 8-foot channel was considered in the analysis because this was the design depth that allows the vessels passage in and out of the cove at all tidal stages. However, the analysis also shows that the 8-foot channel depth is essentially advanced maintenance dredging, allowing the capture of more benefits for less annual dredging. Where it was estimated to require three maintenance events per year to obtain \$353,000 in project benefits, based on the average 6 inches per month shoaling rate, the same benefit level could also be achieved with only two maintenance events per year for the 8-foot channel.

The following estimates, also used in the Detailed Project Report, are based on disposal in the area of Lighthouse Beach.

Annual Maintenance Cost
Plan B - Channel South of Tern Island
(Maintenance Disposal at Lighthouse Beach)

Maintenance 3X/year	\$624,000
Maintenance 2X/year	\$438,000
Maintenance 1X/year	\$304,000

As just discussed the 8-foot channel could be dredged twice per year, which would result in a cost savings of \$186,000 in annual maintenance costs. Dredging once per year would save even more costs, but project benefits would also be reduced (see input on chapter 7 for sensitivity analysis of benefits).

It should be noted that the figures presented in the table above are only maintenance costs. The annualized initial construction cost, with disposal on Tern Island (\$44,000 for the 8-foot channel, \$32,000 for the 6-foot channel, and \$23,000 for the 4-foot channel), is added to these figures to arrive at the total annual cost.

Total Annual Cost
Plan B - Channel South of Tern Island
(Maintenance Disposal at Lighthouse Beach - 50 years)

	<u>8-Foot Channel</u>	<u>6-Foot Channel</u>	<u>4-Foot Channel</u>
Maintenance 3X/year	\$668,000	\$656,000	\$647,000
Maintenance 2X/year	\$482,000	\$470,000	\$461,000
Maintenance 1X/year	\$348,000	\$336,000	\$327,000

Whether or not the same shoaling rate would apply to a channel deeper than 8-feet below MLW is unknown. Recent dredging practices in the cove are only to depths of 8 or 9-feet below MLW. Pre and post-dredge surveys from recent work in the area confirm the previously estimated annual shoaling rates. NED does not know how shoaling in the channel would react if depths were deeper than those previously dredged. Experience indicates that the deeper, or more unbalanced compared to surrounding bathymetry the channel is, the quicker the area will tend to shoal-in to reach equilibrium. In addition, the cost per cubic yard of material increases the deeper dredging occurs. Also, a greater depth of dredging requires a significantly greater amount of material removed. For example, if the channel was dredged to 13-feet below MLW initially, it is estimated that shoaling rates would increase to about an average 9 inches per month. This means that once a year the channel would need to be dredged so that the full project benefits would be realized. In this example, advance maintenance would gain six months time (over say the 2X/year for the 8-foot channel) before dredging was needed but the dredging quantity would triple to about 61,000 cubic yards. The costs saved in dredging once each year, down to 13-feet below MLW, would be negated by the added dredging costs due to increased pumping depth and quantities

For these reasons, advanced maintenance is not favored beyond the 8-foot depth. Whereas there is a limited understanding of how the channel behaves if the channel is dredged to 8-feet below MLW, there is none at greater depths. In addition, the added costs of pumping at greater depths, the channel shoaling-in more quickly, and the greater amounts of material needed to be removed, would offset any savings to be gained.

9. STATIONED DREDGE AND MULTI-YEAR CONTRACTS

Provide an analysis of the alternative of purchasing a dredge to be dedicated to maintenance of Chatham Harbor. Also investigate potential of cost savings associated with multi-year contracts.

Discussion: While it was clearly stated at the meeting that this alternative would most likely not receive support by higher Government authority for many reasons unrelated to economics, it still remains an alternative that must be evaluated.

Input: In order to achieve annual, or several maintenance operations during the course of a year, an initial plan was formulated to station a

dredge at Aunt Lydia's Cove. This plan is described in detail in the draft Detailed Project Report. The cost estimates for dredging the channel and anchorage at Aunt Lydia's Cove, shown in tables 2-6 and 2-7 of the Engineering Appendix, are based on the stationed dredge concept.

Pumping 21,400 cubic yards of material to Tern Island annually was estimated to cost \$172,000. This cost is based on an initial purchase price, for a portable 10" hydraulic cutterhead dredge, of \$350,000. Ownership costs translate into \$30,000 a year. Additional costs for operating the dredge including labor, preconstruction engineering, and construction management of the work, were included in the estimate. This plan also included a confined disposal facility (CDF) on Tern Island where dredge material could be stockpiled and removed when capacity was reached. An additional \$110,000 was also included in these estimates to account for maintenance of the CDF. Again, the annual maintenance dredging cost, the CDF cost, and the annualized initial construction cost, would be added together in order to arrive at the total annual cost of a project.

Total Annual Cost
Stationed 10" Hydraulic Dredge and CDF

8-Foot Channel	\$326,000
6-Foot Channel	\$314,000
4-Foot Channel	\$305,000

Since the CDF was not an acceptable solution to the Massachusetts Audubon Society and long-term disposal on the island was not feasible, an alternative stationed dredge plan was investigated. This plan would involve purchasing and stationing a 14" hydraulic cutterhead dredge and all supporting equipment at Aunt Lydia's Cove. By purchasing a larger piece of equipment, an advantage is gained in that material can be pumped greater distances to alternative disposal sites (e.g. Lighthouse Beach). The total initial purchase price of this equipment is estimated to be \$1,185,000. This cost is broken down as follows:

Ellicott 670 Dredge	\$750,000
500 HP Booster Pump	200,000
1.5 miles of 14" Polyethylene Pipe	200,000
Work/Crewboat	20,000
Miscellaneous Yard Equipment	15,000

The annualized cost for this plan, including ownership (\$145,000) and operation and maintenance (\$138,000), is \$283,000.

The potential cost savings associated with multi-year contracts, for maintaining a project at Aunt Lydia's Cove, is first of all not institutionally feasible. Coordination with the NED Contracting Directorate determined that this method of contracting is not allowed on construction projects, whether it is initial construction or maintenance

dredging, as it would violate the requirements of the Competition in Contracting Act of 1984. One contract spanning several years would completely eliminate the requirement for open competition in the contracting process.

If multi-year contracts could be established, it is doubtful they would work, much less save costs. Maintenance funding in the Federal government is allocated on a year to year basis. There is no guarantee that funding would be available in any given year, much less every year. There may be some savings in advertising and negotiation of contracts. However, it would be extremely difficult, for both the Government and the contractor, to enter into an agreement that would be based on a prediction of future funding, site conditions, quantities, wage rates, fuel costs, and environmental windows. These factors tend to change with time and would result in substantial contract claims.

10. SPAR CHANNEL/BREACH RELATIONSHIP

The analysis should take into consideration that tidal delays at the breach and at the spar channel may be different because of different channel depths.

Discussion: The project benefits and costs should be based upon the draft restrictions at both the spar channel and breach which control vessel entry and exit in the with-and without-conditions. The spar channel should be dredged to match the restrictions at the breach. A greater depth at the spar channel would not be usable and lesser depths at the spar channel would cause additional delays.

Input: The analysis does take into consideration the differential in depths between the spar channel and the breach when estimating delays in the spar channel. If this were not the case then providing additional depth in the spar channel may not reduce delay there but only transfer it to the breach. Delays that are calculated for the spar channel would only occur when there is enough water in the breach to allow passage.

11. COUNTY DREDGE ALTERNATIVE

Evaluate the alternative of use of the County dredge.

Discussion: At the meeting it was stated that the County dredge would most likely not be available, but no rationale was given for why it could not be made available. However, reasons which may affect an alternative's implementability do not predispose it from being evaluated.

Input: Letters provided by the Massachusetts Coastal Zone Management Office dated March 27, 1992 and by the Massachusetts Department of Environmental Management dated August 18, 1992 and April 20, 1993 indicate that the state is establishing a County Dredge Program for Barnstable County (see Appendix 2). The program involves the capital outlay for purchase of a dredge and subsidized (75%) maintenance of navigation projects in the Cape Cod area. The program involves communities requesting dredging projects for which the local cost share (25%) is

funded and all permits are secured. A committee is currently evaluating a list of requested projects. The dredge equipment is anticipated to be available some time in 1993. The letter from MDEM also states that the dredge "could only be considered for one project at Aunt Lydia's Cove annually".

The correspondence from the Commonwealth of Massachusetts clearly indicates that the County Dredge could be made available for dredging in Aunt Lydia's Cove and provide a viable means of maintaining the channel and anchorage area on a once per year basis. If the channel and anchorage were scheduled to be dredged by May of each year the majority of the benefits discussed earlier in chapter 7 would be captured.

Subsequent information provided by MDEM shows that the ownership cost for the County Dredge, based on amortization rates over the life of the equipment, is very similar to the 14" hydraulic dredge plant estimated by NED in chapter 9 above. Projected operation, maintenance, and management expenses for the County Dredge are on the order of \$470,000 annually. This obviously exceeds NED's estimate since the County Dredge is projected to be used for several more jobs per year.

The town of Chatham could take advantage of the benefits of the County Dredge Program. Not only is there a 75% subsidized benefit, but also the lowered costs due to reduced mobilization/demobilization and lack of contractor's profit. It is not known to what extent these latter savings exist since there is no track record of operating expenditures for the program. However, if one compares the estimate of dredging, by contract, shown in chapter 8 (\$304,000) with the estimate for stationing a 14" dredge on site in chapter 9 (\$283,000), a potential savings of \$21,000 seems possible.

If the Corps of Engineers became responsible for maintaining a navigation project at Aunt Lydia's Cove, maintenance contracts would be prepared in accordance with the Federal Acquisition Regulations (FAR), the Department of Defense FAR Supplement, the Army FAR Supplement, and the Engineer FAR Supplement. These regulations require competitive bidding/negotiating procedures to obtain services for Federal projects. Therefore, linking the County Dredge Program with any Federal navigation project is not feasible at this time.

12. BENEFITS TO THE U.S. COAST GUARD

Provide a clear description of expected Coast Guard actions in the without project condition.

Discussion: During conversations with the local sponsor, it was implied that the Coast Guard would experience delays passing the spar channel if they continued to anchor within the Cove. And, if they anchor outside the Cove this will impede mobilization of rescue procedures. On the other hand, we understand that the Coast Guard would respond by using an inflatable boat to get from the dock area to the rescue ship anchored outside the Cove. The question is, besides the added cost of the inflatable boat, have other costs been adequately assessed, such as maintaining a 24 hour watch on the out of Cove rescue ship, between the without and with project conditions?

Input: There are additional costs incurred by the Coast Guard that are not covered in the report. These costs are associated with keeping the 44' vessel at a mooring outside the cove. In the without project condition the 44' vessel would be moored on a buoy outside the cove. The standard procedure is to check the condition of the vessel each day to make sure the vessel is ready for emergency response. When the vessel is tied up at the dock inside the cove this is quickly done by the two man crew and then they return to the station. When the boat is moored outside the cove, an additional two men are needed to man the inflatable boat that carries the crew through the channel to the 44' vessel. The vehicle that drops the crew off at the dock then leaves for Stage Harbor. Under existing conditions when the 44' vessel is at the dock inside the cove, the vehicle waits for the crew to check out the vessel and then leaves. Because of the additional time needed to inspect the 44' vessel, in the without project condition the vehicle would leave for Stage Harbor after dropping off the crew and then return to pick them up. The additional travel cost was estimated to be \$500 per year.

Another cost is the annual inspection of the mooring buoy. To accomplish the inspection a vessel is sent from Woods Hole every two years. The chain must be lifted and the buoy inspected. One way mileage from Woods Hole to Aunt Lydia's Cove is approximately 70 nautical miles. This is a three day trip - two days steaming and one day for the inspection. The Coast Guard estimates the cost at \$3500 per day or \$10,500 for the entire trip. In the off year the buoy is inspected by a diver at a cost of \$75. The annualized cost of buoy inspection is \$5,500.

13. AVERAGE VS EXPECTED DELAYS

Average delay time is not a good measure. Benefits should be recomputed based on the distribution of expected delays, including delays on both the outgoing and incoming trip. Differentiate the economic consequences of inbound and outbound delays and the loss of economic opportunities for long and short delays.

Discussion: Fisherpersons can have a higher chance to fish on a day with a short delay as opposed to an outbound delay of several hours which results in the entire fishing day being lost as well as any opportunity to work in a landside occupation such as landscaping. If fisherpersons are delayed returning to port, the owner and crew have to pay contractors to perform labor such as bating hooks. If the crew could get to shore on schedule, they could perform this work instead of duplicating hired labor because the crew is experiencing delay time and cannot get to the shoreside work site.

Input: Average delays assumes that the delays are random in nature when in reality some of the longer delays could be avoided through trip planning. Thus the distribution of delays would be truncated omitting the longer delays. This would reduce the average delay and thereby reduce benefits. The fishermen reported 6320 hours of delay. Using an average crew size of 2.5 fishermen per boat this would result in approximately 15,800 hours of delay for the fleet. In the analysis the estimated hours

of delay based on the tide cycle was approximately 17,700. If the difference of 1900 hours can be interpreted as an overstatement of delays then benefits are overstated in the report by \$7,000 using one third the average wage. Thus project benefit would be \$346,000. Delays could occur both incoming and outgoing. In situations when delays are long outgoing the fishing trip may be eliminated. The fishing fleet estimated that 529 trips would be lost in the without project condition.

Inbound delays may pose additional problems to hook fishermen. Delays incurred by hook fishermen on the inbound trip could pose an additional cost if the crew is unable to bait hooks for the next fishing trip. In the without project condition these additional costs would need to be accounted for. Based on information provided by a fisherman, it is estimated that this cost could be approximately \$51,200 annually (based on 1/3 the hourly wage). The vessel owner/operator with a share system would retain about 2/3 's of this cost saving. Thus with the project owner/operator income will increase by \$34,300. It should be pointed out that some hook fishermen customarily bait their own gear while others hire this service.

14. BENEFICIAL USE OF DREDGED MATERIAL

Consider storm protection potential for all material and maintenance dredging to be disposed of on Lighthouse Beach.

Discussion: In the report, the initial dredging material was to be disposed of on Tern Island. Discussions with NED indicated that placement of maintenance material would have little protection value, because of the limited time a small amount of material would stay on the beach. However, there may be some storm protection potential for the much greater amount resulting from initial dredging.

Input: In the draft detailed project report storm protection benefits were not considered as part of the disposal of maintenance material at Lighthouse Beach. This was because it was believed that such small quantities of material (7,000 - 14,000 cy) would not remain for very long in this area of intense waves and currents.

The placement of larger initial dredge quantities (e.g. 86,000 cy) was also considered. The town of Chatham, in early 1992, constructed a substantial rock revetment along the bluff behind Lighthouse Beach. The structure has since been through several coastal storms and is providing more than adequate protection against further erosion (as many other revetments up and down the shoreline in this area appear to be doing). Therefore, it is difficult to justify a storm protection benefit for the placement of any amount of material. The disposal of material there may provide some additional protection to the revetment itself. If we were to conservatively assume that the disposal material eliminates the future maintenance costs of the revetment, the annual benefit would be \$500. This figure is the annual maintenance cost associated with a revetment designed by the Corps in 1992 for the same area.

The potential for recreational benefits was considered, but found to be not justifiable. This was due primarily to the fact that it was not known what would happen to the material that is placed on the beach. The beach is located directly across from the breach and is subject to intense

wave and current energy. To what degree the dredged material is impacted by these forces could not be determined. Also, Lighthouse Beach is currently a publicly accessible beach, but the potential for significant increased use is questionable. Parking is very limited in this part of Chatham and there are other publicly accessible beaches in this area of Cape Cod that can be utilized.

15. UNDERUTILIZED SPECIES

The application of 1/3 the wage rate (leisure or unproductive waiting and delay) would not apply in the case of harvesting underutilized species. Updated input is needed from NMFS on the status of underutilized species, such as lobster.

Discussion: The report shows 17 lobster boats. This fishery is not overharvested. Therefore, any daylight time saved could be used in increasing the national harvest of lobster. The benefits would be measured by the revenue (ex-vessel price of fish) less incremental harvest cost. Other vessels in the Chatham fleet may also be going after underutilized species. An increase in net income would also apply for these vessels going after underutilized species.

Input: NMFS does not assess the inshore lobster stock. Their assessment of the offshore stock is that it is fully exploited, with recent mortality rates greater than the point that defines growth overfishing.

The following analysis describes NED benefit derivation for increased lobster catch in the with project condition. In the Detailed Project Report lobster was treated similarly to cod as it is an overfished species and any income loss to Aunt Lydia's Cove lobstermen in the without project condition would be transferred to lobstermen outside of Aunt Lydia's Cove. Thus there was no NED benefit derived for increasing lobster catch.

Of the 17 lobstermen identified in the Project Guidance Memorandum, five are full time fishermen accounting for approximately 95 percent of the catch. Interviews with these fishermen (see Appendix 3) indicated that two would go out of business, one would relocate to Stage Harbor and one would relocate to Sagatucket Harbor, and one would most likely continue to operate out of Aunt Lydia's Cove. Thus in the without project condition there would be an estimated 66% reduction in lobster pots hauled by these fishermen. It is assumed that the reduction in catch is proportional to the decrease in effort. This assumption is based on a constant setover period for pots and the difficulty of other fishermen expanding their pots into areas vacated by existing lobstermen. The setover period is affected by lobstering conditions near Chatham, such as water temperature, water depth, type of bait used, and the speed of the lobster migration. These conditions would not vary between the with and without project condition.

Due to the distance to Chatham from other ports it would be costly for fishermen to expand effort there. In addition, new entry into the market would be difficult as there have not been any new coastal lobster licenses issued in Massachusetts since 1988.

In 1992 the total quantity of lobster landed at Aunt Lydia's Cove was 199,100 pounds. Thus a reduction of 66% would be approximately 131,400 pounds per year. Valued at the ex-vessel price of lobster for Barnstable County of \$3.29, lobster revenues would decline by approximately \$432,300 annually. The reduction in effort would also reduce current harvesting costs. Estimated decreases in harvesting cost are summarized as follows:

Fuel Cost	\$ 3,100	
Labor Cost	\$77,800	(\$26,000 at 1/3 wage)
Bait Cost	\$16,000	
Pot Replacement Cost	<u>\$ 7,400</u>	
Total Cost	\$104,300	(\$52,500 at 1/3 wage)

Thus the net decrease in annual revenue is \$328,000 (\$379,800 at 1/3 wage rate). This benefit is questionable. Its derivation assumes a direct and constant relationship between effort and catch. Recent NMFS data indicates that the offshore fishery is overfished and past studies have indicated the same for the inshore fishery.

Landings of underutilized species are estimated to be \$400,000 annually and account for approximately five percent of the landings at Aunt Lydia's Cove. These fish are caught primarily by draggers. It is estimated that a 10 percent reduction in effort would result in a ten percent reduction in catch. Thus the without project condition would reduce revenues by \$40,000. If the rate of return is 10 percent, net revenue would increase by \$4,000. Given the uncertainty of this increase in net revenue and its minor importance, no benefit is taken for reduced catch in underutilized species.

16. RECOMPUTED DREDGING COSTS

Recompute the cost of dredging based on bid prices of recent contracts in the area and the information provided by the MDEM for similar work, adjusted to meet known differences of difficulty and requirements imposed by Government contracting rules and regulations.

Discussion: The local sponsor questioned the higher costs used in the Corps estimate based on a written bid proposal of lesser amounts for similar work by a reputable dredge company who has dredged Chatham twice (1989 and 1991).

Input: In the following comparison, the frequency of maintenance dredging is twice per year (only viable for the 8-foot depth to achieve full benefits).

The town of Chatham, in their letter dated February 23, 1992, provided cost estimates for maintenance of the cove based on their previous experience. The estimates are summarized as follows:

Maintenance Dredging with Disposal at Tern Island
(Town of Chatham Estimate)

Mobilization and Demobilization (\$36,000/event x 2)	\$ 72,000
Dredging (\$4.20/cy x 21,400 cy)	90,000
Engineering Costs	<u>25,000</u>
TOTAL ANNUAL MAINTENANCE COST	\$187,000

Maintenance Dredging with Disposal at Lighthouse Beach
(Town of Chatham Estimate)

Mobilization and Demobilization (\$52,000/event x 2)	\$104,000
Dredging (\$5.50/cy x 21,400 cy)	118,000
Engineering Costs	<u>25,000</u>
TOTAL ANNUAL MAINTENANCE COST	\$247,000

The Massachusetts Department of Environmental Management (MDEM), in their letter dated January 21, 1992, stated that prevailing prices in the Cape Cod area would make a more realistic cost for pumping material to Lighthouse Beach to be about \$12.00/cy. This figure includes mobilization/demobilization costs of some unknown amount. If town engineering costs are added, the following estimate results.

Maintenance Dredging with Disposal at Lighthouse Beach
(MDEM Estimate)

Mobilization/Demobilization & Dredging (\$12.00/cy x 21,400 cy)	\$257,000
Engineering Costs	<u>25,000</u>
TOTAL ANNUAL MAINTENANCE COST	\$282,000

The comparable Corps' estimate for dredging and disposing material on Tern Island is different from the town's estimate due to a difference in estimated engineering costs and a lack of contingencies in the town estimate.

Maintenance Dredging with Disposal at Tern Island
(Corps of Engineers' Estimate)

Mobilization and Demobilization (\$50,000/event x 2)	\$100,000
Dredging (\$3.55/cy x 7,000 cy)	69,000
(\$3.13/cy x 14,000 cy)	
Contingencies (20%)	34,000
Engineering Costs (\$59,000/event x 2)	<u>118,000</u>
TOTAL ANNUAL MAINTENANCE COST	\$321,000

Similar variations apply when comparing the Corps' and the town of Chatham's estimates for dredging and disposal of maintenance material on Lighthouse Beach. In addition, there is a difference between the Corps' and town's mob/demob figure (\$169k vs \$104k).

Maintenance Dredging with Disposal at Lighthouse Beach

(Corps of Engineers' Estimate)

Mobilization and Demobilization (\$84,400/event x 2)	\$169,000
Dredging (\$5.30/cy x 7,000 cy)	93,000
(\$3.97/cy x 14,000 cy)	
Contingencies (20%)	52,000
Engineering Costs (\$62,000/event x 2)	124,000
TOTAL ANNUAL MAINTENANCE COST	\$438,000

The Corps' and MDEM's combined mob/demob and dredging estimate, for disposal at Lighthouse Beach, are also very similar (\$262 vs \$257).

For disposal at Lighthouse Beach, the mob/demob costs can be expected to be significant since the contractor will utilize between 7,000 and 8,000 feet of pipeline, a booster pump, a work barge, and a workboat/launch. Several days of set-up time will be required. In addition, the contractor assumes greater risks associated with 1.5 miles of pipeline exposed to the open ocean.

NED costs were developed based on both past dredging projects and current equipment and labor costs. Our experience indicates that increased mob/demob costs and decreased production rates will cause significant additional costs when compared to the dredging costs involving disposal of material on nearby Tern Island. A 1992 construction contract supports this view.

At the Wood Island Harbor project in Maine the low bidder cost estimate for a recently awarded Corps dredging project illustrates the high mobilization/demobilization and dredging costs associated with a hydraulic pipeline dredge with 2,000 - 3,000 feet of pipe.

Wood Island Harbor, Biddeford ME - Jan. 1992

<u>DESCRIPTION</u>	<u>COST</u>
Mobilization and Demobilization	\$ 58,500
Dredging (\$12.21/cy x 17,000 cy)	207,600
Engineering Costs	53,900
TOTAL	\$320,000

This translates into a \$18.82/cy cost. Other projects awarded by this office in the past five years support this recent experience.

A major difference between the Corps' estimates and those of the town and MDEM is the inclusion of a contingency and larger engineering costs. Contingencies are based on the variation in quantities. Given the high shoaling rate within the spar channel, there is a substantial uncertainty regarding quantities. Based on the average shoaling rate the spar channel would shoal approximately 1,000 cy/month. Maintenance contracts would not be implemented in exact intervals, therefore, a variation in quantity will occur. Also, shoaling during the dredging operation will change the site

conditions. If a large storm occurs this change could be significant. Engineering costs, which include planning, engineering, and design (PE&D) and construction management (CM) costs are based on expenditures from previous Corps dredging projects. PE&D costs include the preparation of plans and specifications (including a hydrographic specification survey), securing all necessary permits, and engineering during construction (estimated at 1% of construction cost). CM includes all supervision and administration costs (estimated at 6% of the construction cost), the pre-dredge survey and payment survey cost.

APPENDIX 1

ECONOMIC DOCUMENTATION

New Direction for Groundfish Management Summary of Amendment #5 Measures

Prepared by the New England Fishery Management Council

The following summary is intended to inform fishermen about the major elements of the program being proposed for Amendment #5 to the Northeast Multispecies Plan. The New England Fishery Management Council and its Groundfish Committee look to the fishing community to help identify problems and develop solutions at public hearings planned for late April.

In recent years, the New England Fishery Management Council and many fishermen have abandoned the debate over whether heavily fished groundfish stocks are depressed. A steady decline in fishermen's catch and volumes of scientific evidence support this fact. Both sets of information point to the pressing need to reduce fishing mortality.

The Groundfish Committee has dedicated itself to the painstaking business of piecing together a program to rebuild fish stocks that can support a more profitable and stable fishing industry. Fishermen now are asked to participate in the public hearing process to help the committee and council define a program that will work.

Many fishermen have become familiar with the proposed package by attending meetings or talking with each other. Many have questions. Industry concerns and questions will inevitably be raised by some measures in the package. Some will be explained in the public hearing document. Others will be dealt with during discussions at the hearings. Public input is expected to supply the information to further evaluate the program and make necessary adjustments.

This outline provides a brief description of the principal measures contained in the package already approved by the New England Council for review at the hearings. Other additions and refinements to these measures will be included in the final version of a program document which will be widely distributed in early April.

Purpose and Objectives

Amendment #5 proposes a five-year program to 1.) rebuild stocks of cod, haddock, and yellowtail flounder to levels which will allow these species to maintain themselves at long-run average levels; 2.) rebuild haddock stocks; 3.) protect concentrations of small fish; and 4.) improve the administration and enforcement of fishery management rules.

To achieve these goals the Council has agreed to a program which proposes to reduce fishing levels by 50% primarily through reductions in fishing effort. A moratorium on new entrants into the multispecies fishery would be imposed during the rebuilding period. Effort reductions would occur on a schedule of 10% per year until the 50% target is reached at the end of year five. A review in the third year would determine whether any adjustments in the reduction schedule would be required.

Specific Measures

□ **Moratorium.** Vessels would not be allowed to commercially fish for multispecies cod, pollock, haddock, redfish, yellowtail, winter and windowpane flounder, gray sole, American plaice, white, silver and red hake, and ocean pout, unless they landed at least one of these species and held a multispecies permit at some time between Jan. 1, 1990 through Feb. 21, 1991. Party and charter boats would be subject to similar moratorium provisions.

The moratorium will prevent new fishermen from entering the fishery at a time when today's fishermen are being asked to cut back their effort.

□ **Fishing effort reductions.** Days at sea spent fishing for groundfish would be reduced by 10% per year for five years. (For the purpose of this amendment "groundfish" refers to the 10 large mesh species—all the species listed above except silver and red hake and ocean pout.) Phased-in effort reductions are structured to effect gradual changes and still meet the plan objectives within five years.

Specific reductions would be based on vessel tonnage class:

● **Mobile gear vessels 61 gross registered tons (GRT) or larger** would calculate their future days at sea based on the individual vessel's fishing history from 1988 through 1990.

● **Vessels smaller than 61 GRT** have a choice—either days at sea based on their individual history or an allocation of blocks of time based on the vessel group history, initially seven half-month periods. Individual days or blocks could be taken at any time throughout the year and would apply only to fishing for groundfish species listed under the "fishing effort reduction" measure.

Many vessels in this group traditionally switch to fisheries other than groundfish at different times of the

year. Therefore, their initial allocation of groundfish days is smaller than their total days at sea.

For vessels with accurate records in the commercial fisheries database, this program will allow precise effort reductions.

Days at sea for vessels less than 61 GRT are based on this group's history of fishing for groundfish in the database. The group average has been adjusted upward by not counting vessels with 14 or less days on record and by allowing seven or eight layover/weather days for every eight days at sea. In other words, each half-month represents eight days deducted from the total allocation of days at sea. Vessels in this group could fish the entire one half-month period, weather permitting.

□ **Possession limit.** A vessel which holds a groundfish permit but which is not fishing under its allocation of days (or has used up its allocation) may possess up to 1,000 pounds of groundfish if it is 61 GRT or larger, or up to 500 pounds if it is under 61 GRT. This would allow a vessel to retain an incidental bycatch of groundfish while fishing for other species.

□ **Separate rules for gillnetters and hook fishermen.** Gillnet vessels which use 8" or larger mesh exclusively and hook gear vessels fishing with less than 4,500 hooks per day (including rod and reel fishermen) would not be included in the "days at sea" program. Vessels must fish for groundfish in one of these categories for the full year.

● **Gillnet vessels fishing with 6" mesh** would calculate their fishing days differently from mobile gear vessels to account for longer soak times. Methods to determine these numbers are undergoing review.

● **All gillnetters** would be limited to 100 nets of 50 fathoms in length and would be required to haul through their gear once every 48 hours.

□ **Electronic tracking devices.** All vessels fishing under an individual vessel allocation of days at sea would be required to use an electronic vessel tracking system. These devices could be equipped to provide confidential communications and improved safety and navigation features. The vessel owner is responsible for the cost of buying or leasing the equipment.

□ **Mesh size increase to 6" (diamond or square).** This measure would apply initially to gillnetters and to cod end mesh in mobile gear. Following a one-year phase-in period, the mesh increase would be required throughout the net.

6" mesh will reduce capture and discards of small fish of all species. It will also contribute to an increase in spawning potential.

□ **Extension of large mesh regulations.** The 6" mesh size would apply throughout the range of the species regulated under the Groundfish Plan. A small mesh fishery (exempted from the mesh rules) would be established outside the current Regulated Mesh Area and would be in addition to the existing Exempted Fisheries Program in the Gulf of Maine. The Southern New England Yellowtail Closure Area would be eliminated. Vessels in this small mesh fisheries program would be subject to a groundfish bycatch limit of 10% per trip. The proposal should provide substantial conservation benefits to yellowtail and winter flounder, and cod in southern New England.

□ **2,500-pound trip limit for haddock.** The measure would eliminate the directed fishery for haddock in order to help rebuild stocks. The limit is set high enough to accommodate the bycatch, but low enough to discourage most vessels from targeting haddock.

□ **Changes to haddock closed areas.** To more accurately reflect the current distribution of haddock, closed Area I would be suspended. Area II would be enlarged by moving its boundary 20 minutes to the west and 15 minutes to the south.

In the third year, the closure would extend from Jan. 1 through June 30, instead of the current time frame of Feb. 1 through May 30.

□ **Minimum fish size changes.** The minimum size for cod caught by recreational fishermen would be increased to 21" and the size of winter flounder (blackback) would be increased to 12" for both commercial and recreational fishermen. The minimum sizes for other species might be changed (down or up) to better complement the mesh size regulations.

Proposed changes in fish sizes are intended to reduce the number of small fish caught by the net, but will allow fishermen to keep most of those that actually are retained and thus reduce mortality due to discards.

Questions and Answers

Q. Why an effort reduction program rather than a quota system?

A. The proposed program allows fishermen flexibility within the overall limits on days in the groundfish fishery. There are no limits on how much or what species may be caught on a groundfish trip, with the exception of haddock. Fishermen may take advantage of the availability of different species, seasonal weather conditions, and market prices. Historically, quota systems have caused highgrading and discarding in multispecies fisheries. The type of program would also avoid the "cold rush" behavior and across-the-board tie-ups caused by fleet quotas.

Q. Why the reluctance to use mesh size alone?

A. Increasing the mesh size to 6" will not achieve the spawning potential targets outlined in the plan objectives. Additionally, while many fishermen are now complying with mesh regulations, others use liners or restrict the cod end mesh openings with little chance of being detected. Enforcement agencies have told the Council it is very difficult, if not impossible, to improve the poor enforcement of mesh regulations.

Q. Will effort controls be enforceable?

A. A vessel with more than the allowable groundfish bycatch could be easily identified at sea or at the dock and would be subject to severe penalties, up to and including loss of permit. Vessel operators and fish dealers would also be accountable and risk permit sanctions for violations. Electronic tracking devices for some vessel groups will allow for automatic monitoring of days at sea.

Q. Will fishermen be able to participate in other fisheries that have control dates?

A. Many fishermen who hold groundfish permits also have permits and/or established track records in other fisheries and are likely to qualify under the terms of the control dates. But the ability of fishermen to participate will depend on the rules for those fisheries.

Q. If I am having trouble making ends meet now, how am I going to survive a 10% per year reduction in the amount of time I can catch groundfish?

A. As fishing mortality decreases, fishermen will eventually benefit from larger fish, higher catch rates, and higher landings than without the proposed program.

Q. What if the days at sea allocated to my vessel do not correspond to the amount of time I recorded fishing for groundfish?

A. Vessel owners will be sent a letter notifying them of their groundfish days and total days at sea. If there is a discrepancy, fishermen should gather all the evidence that might substantiate the number of days actually spent at sea fishing for groundfish. This information can be used in an appeal process. Written comments to the Council office, accompanied by documentation also will help managers evaluate whether adjustments to the allocation system are necessary.

□ **SNE Yellowtail Area to protect small fish.** While the Northeast Fisheries Science Center's spring bottom trawl survey indicates an unusual abundance of age 2 yellowtail flounder, an area in southern New England near the Nanuet Lightship would be closed for about 12 to 13 months to all gear capable of catching yellowtail flounder. Such a threshold abundance has occurred five times during the past 25 years.

The measure should prevent discards of large amount of small fish. For example, in 1988 and 1989 millions of small yellowtail were discarded in this area at rates as high as 75% to 80% of the fish caught.

□ **Stellwagen Bank and Jeffreys Ledge Control Areas.** To protect large seasonal concentrations of small cod, 6" square mesh would be required 140 bars from the end of the net from March 1 through July 31 each year. Fishing for shrimp would only be allowed with finfish excluder gear and with no groundfish bycatch.

This measure is intended to prevent wholesale discards of small cod in the future. Based on landings and sea sampling data for 1990, failure to protect these fish resulted in potential lost landings of over 1 million pounds of fish.

□ **Permits for vessel operators and dealers.** These measures would promote accountability and enhance monitoring, enforcement, and administration of the management program.

□ **Mandatory reporting.** This would improve the database used to calculate fishing effort. ■

For more information on Amendment #5 proposals, contact Council staff member Patricia Fiorelli at (617) 231-0422.

Cod, haddock, yellowtail: Assessments detail groundfish outlook

The report presented on the following two pages is from a talk given by Dr. Vaughn Anthony, chief of the Northeast Fisheries Science Center's Conservation and Utilization Division, at the Maine Fishermen's Forum held in March.

In his presentation, Anthony reviewed the status of principal groundfish stocks based on scientific workshops conducted twice each year at the center. During the workshops, stock assessment review committees provide peer review of center assessments.

These committees are composed of stock assessment scientists from the New England and Mid-Atlantic Fishery Management Councils, National Marine Fisheries Service, states, other fisheries science centers, Canada, and academia.

The space for this presentation is sponsored by the Northeast Fisheries Science Center. —Editor

WOODS HOLE, MA - Finfish and squid resources off the Northeast coast of the United States have experienced significant changes in abundance due to fishing during the past 30 years. While some stocks — like mackerel, butterfish, skates, dogfish, and squids — are underfished, groundfish abundance in general has fallen to all time record lows.

Prior to 1960, these fishery resources were fished almost exclusively by the US. The exception was scallops which were fished by both the US and Canada. However, during the '60s, distant water fleets expanded their efforts into this area. As many as 13 nations fished on these resources up until 1976, increasing the catch of most species to record levels.

Figure 1 indicates the total landings of principal groundfish species off the New England and Mid-Atlantic coasts from 1960 to 1991 by US and foreign fishermen. These species are Atlantic cod, haddock, yellowtail flounder, redfish, pollock, silver and red hake, winter flounder, American plaice,

THE TERMS DEFINED

Year Class — The year when fish were born. For example, age 5 cod in 1985 were from the 1980 year class. Normally refers to a group of fish born in a given year.

Recruitment or Recruits — The number of fish added to the fishery each year due to growth and/or migration into the fishing area. For example, in stock assessment studies, it usually refers to the number of new fish in a given age group that are available to be harvested this year, but were not available last year.

Fishing Mortality Rate (F) — The rate at which fish die as a result of fishing. It is proportional to the average number of fish alive during the year. For example, an F of 0.4 means that the fishery catches 40% of the average number of fish alive during the year.

Spawning Stock Biomass — The weight of mature fish in the population that can spawn in that year.

Maximum Sustainable Yield (MSY) — The largest average catch that can be taken annually over a significant period of time from a stock under prevailing conditions of the ecosystem. The spawning stock must be sufficiently large to produce enough recruitment each year to allow this catch to occur.

Catch Per Unit of Effort (CPUE) — The number or weight of fish from a population, or age group of a population, that is caught by a defined standard unit of fishing. Everything is held constant so that the catch varies only as the population varies and therefore is proportional to changes in abundance.

Survey Index — CPUE from a research survey. This refers to a catch per tow from the spring or autumn bottom trawl surveys conducted by the Northeast Fisheries Science Center using a standard Yankee 35 trawl, with standard doors, vessel, mesh size, and time of tow. The survey is a stratified random statistical survey.

Metric Ton — 2,205 pounds.

LANDINGS OF PRINCIPAL GROUNDFISH NORTHEASTERN USA

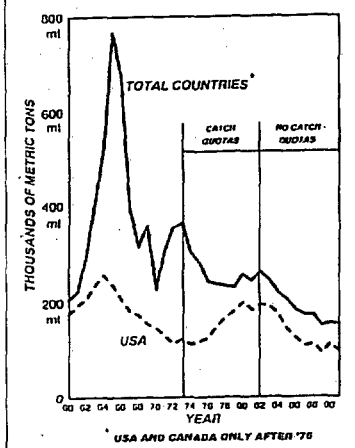


Figure 1.

ABUNDANCE INDICES FOR PRINCIPAL NORTHEAST GROUNDFISH RESOURCES

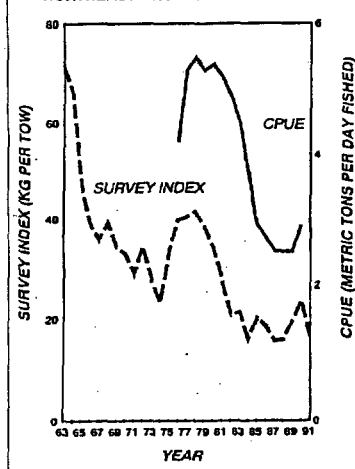


Figure 3.

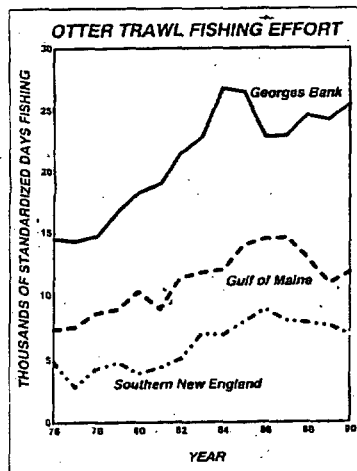


Figure 2.

with flounder, white hake, and summer flounder.

In 1965, about 780,000 metric tons (mt) of groundfish were harvested, including 323,000 mt of silver hake, 155,000 mt of haddock, and 96,000 mt of red

hake. This total of 574,000 mt for these species compares to a US catch today of only 24,000 mt.

As the stocks of fish declined during the late '60s, the foreign fleets moved from one stock to another, overfishing haddock, silver hake, red hake, herring, and mackerel. The International Commission

for Northwest Atlantic Fisheries (ICNAF), which had been the international fisheries management body for such fisheries since the mid-'50s, attempted to control fishing effort with mesh sizes and closed areas.

These indirect management controls, however, were no match for the heavy fishing pressure until catch quotas were introduced along with national allocations of these quotas in 1973.

Twenty-three stocks came under catch quota control in 1973, and 54 catch quotas were put into place in 1974. Landings rapidly declined as the catch quotas were reduced (Figure 1).

Catch quotas

The Magnuson Fishery Conservation and Management Act began in 1977 and excluded fishing on these stocks by foreign nationals except for Canada. The pollock catch is shared with Canada as this stock migrates back and forth across national boundaries. Cod and haddock are also caught by Canada on the Northeast peak of Georges Bank.

Catch quotas continued under the management of the New England Fishery Management Council until 1982. Figure 1 indicates the increase in landings by the US after 1973 to about 200,000 mt in 1980-1983. The landings steadily declined after 1983 as groundfish stock abundance also declined.

These events made it very clear that the waters off the Northeast coast of the US are among the most productive in the world: With proper husbandry of the resources, as much as 400,000 mt of the major groundfish species can be harvested each year, which is more than 3 times the groundfish landed by the US in 1991.

Canada has traditionally caught 25% of these resources and probably would continue to catch substantial amounts of cod, haddock, and pollock if the stocks were rebuilt. The US still, however, could more than double its share of the catch and still not overfish the stocks.

Fishing effort

Figure 2 indicates the days fished by the otter trawl fleet from 1976 to 1990. Fishing effort increased by 80-100% from the mid-'70s to the mid-'80s. In addition, new vessels replaced old vessels, larger vessels replaced smaller vessels, and electronics improved.

By the late '80s, 14 out of the 21 stocks of the 13 species being managed under the New England Council's Northeast Multispecies (groundfish) Fishery Management Plan were overexploited. In some years, as much as half of the stock

of fish was caught in a single year.

Figure 3 shows two indices of abundance for the 13 principle groundfish species. These figures are derived from the otter trawl commercial catch per day fished, and from the autumn bottom trawl research survey conducted by the Northeast Fisheries Science Center.

The research survey began in 1963 and indices over that time indicate a great reduction in abundance. These indices agree as to the declines in abundance after 1980. The high levels in the early '60s were a result of underfishing and an accumulation of old-age, slow-growing stocks of fish such as redfish, hakes, and large year classes of haddock.

These high catches could not be sustained and the stocks declined very rapidly until 1974. At that point fishing restrictions under ICNAF and good year classes of cod and haddock produced a sharp increase in abundance.

The abundance declined during the '80s, but increased in 1989 and 1990 due to good year classes of cod and a good year class of yellowtail flounder.

Examples of the status of groundfish resources are shown in Figures 4-9 for Georges Bank cod, southern New England yellowtail, and Georges Bank haddock.

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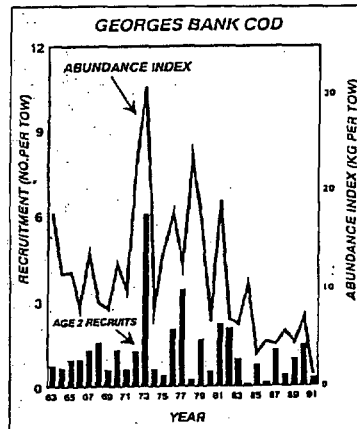


Figure 4.

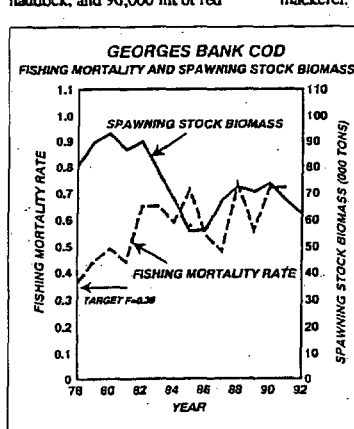


Figure 5.

Georges Bank cod

Figure 4 shows indices of abundance for Georges Bank cod and of the number of age 2 recruits to the population from the autumn bottom trawl research survey. The height of each bar shows the relative number of age 2 cod that are entering the fishery in the year indicated.

In 1973 and 1977, for example, recruitment was very good. The recruitment in 1987 and 1990 was better than average. The abundance index indicates the overall population abundance including these recruits.

During the '60s when fishing pressure by foreign nationals was very heavy, the abundance index was quite low. It increased sharply during the '70s due to the good recruitment in 1973 and 1977. The abundance declined during the '80s due to heavy fishing and the lack of very strong recruitment for the stock.

Figure 5 shows the increase in mortality rates since 1978 and the change in spawning stock. The fishing mortality rate increased from 0.38 in 1978 to 0.72 in 1991. This is a level of fishing that is twice as high as the target set by the New England council.

The maximum sustainable yield from this resource is achieved when the spawning stock biomass is about 105,000 mt which would produce an annual catch of about 35,000 mt. In 1992, the spawning stock biomass was only slightly above 60,000 mt and declining. Yet, the catch for Georges Bank cod exceeds 40,000 mt. We are catching the fish faster than they can replace themselves.

SNE yellowtail

Figure 6 shows the change in abundance and recruitment for southern New England yellowtail flounder.

During the '60s, the abundance of yellowtail was very high, supporting annual catches of about 28,000 mt. The MSY for this stock is about 23,000 mt, which suggests that the abundance during the '60s was very high indeed.

The stock declined dramatically during the '70s and '80s with a brief increase in abundance in 1982 and 1983, and again in 1989. Fish born in 1980 and 1981 (1980 and 1981 year classes) were responsible for the increase in abundance during 1982 and 1983, and the good year class of 1987 produced significant numbers of age 2 recruits during 1989. These 2-year-old fish, however, were rapidly fished out (Figure 7).

Fishing mortality for the stock was very high during the '80s and, in 1992, stands at a level of F of 1.6. This is 3 times the target level of 0.49 as set by the New England council.

The spawning stock biomass of southern New England yellowtail is currently only at about a level of 3,000 mt. The maximum catch for this stock is only achieved when the spawning stock biomass reaches around 48,000 mt.

To complicate matters, this stock of fish is also at the southern end of its range in the north Atlantic and tends to do poorly under warm water conditions. Productivity and success of this stock, therefore, is not only a function of managing the fishing mortality and the size of the spawning stock, but depends in part on nature providing favorable environmental conditions as well.

Georges Bank haddock

Figure 8 indicates the indices of abundance for Georges Bank haddock along with indices of age 2 recruits. The very strong recruitment levels in 1964 and 1965 are obvious in this figure.

These year classes attracted the Soviet

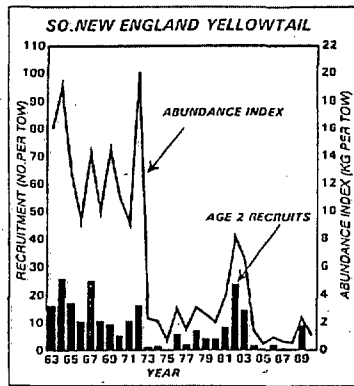


Figure 6.

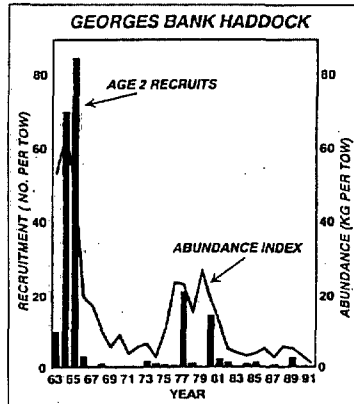


Figure 8.

Union to fish on this stock, and in 1964 they caught 80,000 mt. Along with the 58,000 mt taken by the US and the 18,000 mt taken by Canada, the total catch that year was 156,000 mt. Prior to this binge, Georges Bank haddock had produced annual catches of about 47,000 mt since 1930.

After this period of heavy fishing in the '60s, the only good year classes to come along in this fishery were in 1977 and 1980. These two year classes were quickly fished out. The opportunity for rebuilding this resource was lost and the stock has declined to very low levels.

Figure 9 indicates the changes in the spawning stock biomass and fishing mortality rate for Georges Bank haddock. The current level of fishing mortality is at an F of about 0.5, slightly above the 0.4 target set by the New England council.

Note that the fishing mortality in 1976, 1977, and 1978 was only slightly above 0.2. This allowed the 1975 year class to live long enough to spawn once and produce the 1978 year class.

The abundance of this resource, as indicated here by the spawning stock biomass, however, is at a very low level. In 1992, it is estimated that only 13,000 mt of spawning stock still exist, one-tenth the 130,000-mt level necessary to provide the MSY of just under 50,000 mt annually. The spawning stock biomass, therefore, would have to increase 10 times to be capable of producing the level of catches that were routinely taken during the 1930s, 1940s, and 1950s.

Fishing mortality rates

Table 1 indicates the fishing mortality rates for six major groundfish species off the Northeastern US. These

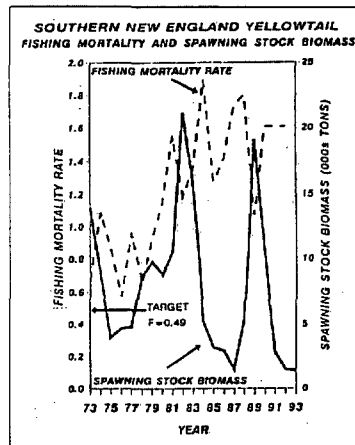


Figure 7.

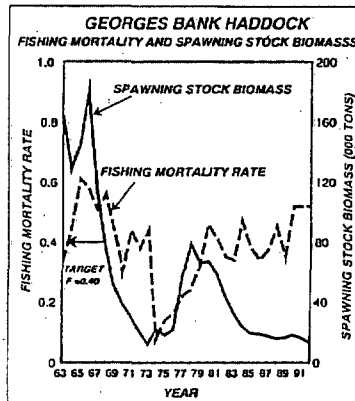


Figure 9.

rates are indicative of the overfishing problem.

The table lists the council's target fishing mortality rates compared to the 1990 fishing mortality rates. This comparison clearly indicates that considerable reductions will have to be taken across the board in order to reach these targets: A 50% reduction in the fishing mortality rate is required for Georges Bank cod; a 57% reduction is needed for Gulf of Maine cod; a 29% reduction is required for Georges Bank yellowtail; a 70% reduction is necessary for southern New England yellowtail; and, a 23% reduction is required for Georges Bank haddock.

An average of a 46% reduction in fishing mortality rate is needed to reach the overall target level as set by the New England council.

Making choices

There is no guarantee that, as the fishing mortality rates reach the target level, the stocks will rebuild in the near future. The low stock levels for Georges

FISHING MORTALITY RATE		
	F 1990	COUNCIL TARGET
GB COD	0.72	0.36
GM COD	0.94	0.40
GB YT	0.82	0.58
SNE YT	1.61	0.49
GB HAD	0.52	0.40

Table 1.

Bank haddock in particular suggest that additional reductions in fishing mortality below the target level might be required to rebuild the stock at a reasonable rate, even though recent levels of fishing mortality have not been much above the target level.

At the same time, there is no reason to believe that the fishery management councils will decide to rebuild the stocks to those levels that would provide the maximum sustainable yield either.

In any event, Table 2 indicates the 1991 catches and the maximum sustainable yields or catches that could be obtained from the 13 species that are currently being regulated by the groundfish management plan.

Along with the catch information in Table 2 are calculated 1992 levels of spawning stock biomass and the levels of spawning stock biomass that would be required to provide the MSY.

The 1991 catch numbers are for the US and Canada combined and for both commercial and recreational fishing. Of the total 1991 catch (157,400 mt), 95,000 mt were taken by the US.

The present condition of the spawning stocks suggests that stock abundance and therefore catches will not increase in the near future unless fishing mortality is cut dramatically.

The decisions on the final level for rebuilding would probably be a function of economics (marketing) and social decisions (allocations) made by the councils.

More information

The three stocks of cod, yellowtail, and haddock reviewed here are only examples of the overfishing problem that exists off New England. The status of the stocks report published by the Northeast Fisheries Science Center in September each year provides similar information on other fish and shellfish stocks in this area.

To obtain a copy of the latest status of the stocks report, write to:

Information Service Section
Northeast Fisheries Science Center
166 Water Street
Woods Hole, MA 02543-1097.

Ask for Technical Memorandum NMFS-F/NEC-86 "Status of Fishery Resources Off the Northeastern United States for 1991." ■

CATCH IN 1991, MAXIMUM SUSTAINABLE YIELD, AND SPAWNING STOCK BIOMASS FOR PRINCIPAL GROUNDFISH STOCKS				
(000's METRIC TONS)				
STOCK	1991 CATCH	MSY	1992 SSB	SSB for MSY
COD-GM	10.7	10	22	30
COD-GB	40.8	35	62	105
HAD-GM	0.4	5	2	15
HAD-GB	6.8	47	13	130
POLLOCK	43.4	54	100	120
REDFISH	0.5	14	25	100
YTF-GB	1.8	16	3	25
YTF-SNE	3.9	23	2	48
OTHERS	41.1	191	169	381
TOTAL	157.4	395	398	954
COMMERCIAL AND RECREATIONAL CATCHES (US AND CANADA COMBINED)				

Table 2.

APPENDIX 2

PERTINENT CORRESPONDENCE



Massachusetts Audubon Society

*South Great Road
Lincoln, Massachusetts 01773
(617) 259-9500*

February 10, 1992

Colonel Philip Harris, Division Engineer
Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Dear Sir:

During the past three weeks the Massachusetts Audubon Society has participated in a new round of discussions with the committee in Chatham that is seeking a long term solution to maintenance of the fishing fleet in Aunt Lydia's Cove.

As you know the primary issue is whether or not there is an economically viable long term disposal site for dredge spoil. The committee believes that Tern Island could be used to accommodate this material, particularly if the tidal zone on the northeastern portions (area C) of our property were included as disposal sites. Our views on this proposal are favorable as it has the potential for assisting us in our efforts to artificially create a nesting area for a variety of state and federally threatened and endangered terns and Piping Plovers that have not nested on the island since 1972. Tern Island was once the most important tern nesting site in Massachusetts, but declined in viability when the Austins, who once managed the island, stopped plowing the beach grass under. Since the 1970s or even before, it has been documented that beach renourishment in the right location may attract large numbers of nesting terns and other coastal nesters. Therefore, the Society has taken advantage of these opportunities at several of its coastal properties (i.e. Popponesset Spit, Cotuit and Dead Neck, Osterville). Both sites received material, attracted terns and plovers the following year and have been maintained since.

12 FEB 1992

During a site visit on January 23, I was very pleased to see the landscaping of existing dredge spoil. Also, I discussed, with the members of the committee, what the Society would require dedicating a greater portion of Tern Island as a long term disposal site. Our preliminary guidelines, pending local, state and federal permitting, are the following:

1. A larger portion of the existing island above the high tide line could be used to accept dredge spoil. About seven (30%) acres have been used as of this date (area A). We have outlined an additional 3.5 acres that could be used (area B).
2. The elevation of the dredge spoil could be increased to a greater overall height of approximately fifteen feet above mean low tide, which would allow for an additional three feet on top of the existing highest point of dredge spoil.
3. The disposal area could be increased by an undetermined number of acres (4+) of the shallow tidal area in the north were also used and the size of Tern Island was increased (area C).
4. The deposition of dredge spoil should occur only when and where it will not have adverse impacts on the nesting waterbirds. Deposition of spoil would not be permitted on certain dates once Piping Plovers or terns have become reestablished. Deposition could occur from September 10 through March 10, with possible additional time of one month both before and after.
5. The dredged material should meet our specifications in its grain size and cleanliness.
6. The spoil area should be landscaped to our specifications concerning its height, shape and contour.
7. The spoil should be planted with beach grass at our specified times and densities.
8. The Society will have an agreement with the contractor and town that frees us from any liabilities concerning the dredging operations and equipment.

These points that I outlined are only meant as a guide concerning what has been discussed informally with members of the Aunt Lydia Cove Committee. I have also contacted the Army Corps and spoken with Chris Hatfield on your staff, to explore the feasibility of this alternative proposal. He was reluctant to

discuss the merits of this proposal until he consulted with other Army Corps staff. After talking to other staff he returned my call and explained he could not comment on the proposal informally, but would wait until he received the proposal in writing from the Aunt Lydia Cove Committee. Therefore, I have drafted these preliminary guidelines to aid the committee and the Corps in the future planning concerning the use of Tern Island. I look forward to continued cooperation on this project.

Sincerely,



Scott Hecker,
Coastal Waterbird Coordinator

SH/lg

Enclosure

cc: Nick Brown, Chairman, Aunt Lydia Cove Cmte.
Bob Prescott, Wellfleet Bay Wildlife Sanctuary
Mark Forrest, Office of Gary E. Studds
Jim Lindstrom, Executive Secretary, Town of Chatham
Gary Clayton, Director of Sanctuary Department, MAS

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NT13081 102.99

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B

C



COASTAL ZONE
MANAGEMENT

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

March 27, 1992

Mr. Joseph Ignazio
Chief, Planning Directorate
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Re: Comments on the Draft Detailed Project Report: Navigation Improvement Study for Aunt Lydia's Cove, Chatham, MA

Dear Mr. Ignazio:

After following the progress of the Aunt Lydia's Cove Study over the past few years, I appreciate the amount of detail that you have put into the Detailed Project Report. I am aware that the comment period for the project has closed, however, I did want to raise these issues of concern regarding the Aunt Lydia's Cove project as well as to the future of the Section 107 Navigation Improvements Program, as implemented by the Corps of Engineers, New England Division.

As pointed out in your report, the options for disposal were limited, and as such you evaluated beach nourishment along the shoreline at the Lighthouse Beach as well as that on Tern Island. This was illustrated in your cost analysis. However, if shore disposal were to be used as a long-term solution, should not the benefits obtained from storm damage prevention, and recreational activities be included in your analysis?

As you are aware, the Corps of Engineers, and the Flood Emergency Management Agency, in cooperation with the Town is working on erosion protection measures at the Lighthouse. Additionally, the town is actively pursuing a long-term coastal erosion management strategy for the shoreline, which could encourage the use of beach nourishment as an option if the material was readily available. Such program partnerships should be encouraged amongst the participants, and the Corps could play a leadership role in working with the locals and the agencies to promote a comprehensive project that would have dual purposes of both improving navigation and flood control. In times where funding resources are limited at all levels of Government, we should be looking to innovative solutions to a variety of problems, and entering into partnerships with those that are in need of assistance.

The report clearly points out that the Federal Government would not consider buying the town a dredge for maintenance, even though this was clearly the most economic means to undertake the project. It is disappointing that the government is overlooking this innovative idea of project implementation, because such an effort is not considered "a general navigation feature". I would however, like to point out that the state legislature has taken an aggressive role to providing such steps for the towns of Barnstable County, by providing \$1.5 million dollars for the purchase and operation of a hydraulic dredge. It is anticipated that the money for capital outlay will be available as of July 1, 1992. Once this is purchased and the program is established by the County, there is an opportunity for communities like Chatham to schedule regular maintenance of their harbor, at a significant savings over Contract bids. The cost would be borne by the Town, however, subsidized by the monies allocated by the legislature and DEM if available. I would strongly

encourage your office to re-evaluate the project utilizing costs that are consistent with this program. Mr. Leslie Lewis, of the Department of Environmental Management has been working closely with Barnstable County on this issue.

I would like to join the Town of Chatham in questioning the validity of assessing the benefit to the fishing industry as a measure of additional "leisure time", valued at \$3.92 per hour. Although you document your reasoning with a survey of eleven fisherman, it is difficult to believe that this would be the most appropriate means to determine such benefit. With 69 boats offloading over 7 million pounds of fish annually, it is clear that this is a major fishing port, and that improvements to the harbor are imperative to continue to support this important industry, as well as the local economy.


With regards to the proposal of the Audubon Society as described by the February 10, 1992 letter to your office, I have some preliminary comments that have been transmitted to Kathy Demos of your staff. Audubon has proposed disposal of dredge material over a four acre intertidal area on the northern edge of Tern Island. This office generally does not encourage destruction of a resource area (intertidal habitat as land containing shellfish) for the benefit of creating a different habitat (supratidal bird habitat).

Specifically, the Wetlands Protection Act (310 CMR 10.34) states that "any project on land containing shellfish shall not adversely affect such land or marine fisheries..". There are provisions in 10.34 (6) that would allow removal of the shellfish to another area if the project were to impact the land containing shellfish. This is contingent upon consultation with the shellfish constable and approval of the Division of Marine Fisheries.

As stated in their letter, this proposal is contingent on state and Federal permitting. I would like to reiterate this provision, and encourage continued coordination with the local conservation commission and shellfish constable, as well as the Division of Marine Fisheries and Coastal Zone Management staff.

Thank you for the opportunity to comment on this project. As stated previously, I feel that the issues represented here are important to resolve for this project as well as looking at the big picture and the role of New England Division as a partner in harbor improvement projects in the Commonwealth. I look forward to your continued cooperation on these matters.

Sincerely,



Jeffrey R. Benoit,
Director

JB/PBR

cc: Congressman Gerry Studds
Andy Young, Board of Selectman
Gene Cavanaugh, DEM
Kathy Demos, ACOE Impact Analysis Division
Scott Hecker, Audubon
Dave Manski, Cape Cod National Seashore
Karen Bugley, DMF, Sandwich



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northeast Region
One Blackburn Drive
Gloucester, MA 01930

June 12, 1992

Morgan R. Rees, Deputy for Planning,
Policy and Legislation
Office of the Assistant Secretary
of the Army (Civil Works)
Room 2E569
The Pentagon
Washington, DC 20310-0108

Dear Mr. Rees:

Since 1989, the Regional Office staff of the National Marine Fisheries Service has interacted with the New England offices of the ACOE regarding the proposed navigation dredging project in Aunt Lydia's Cove in Chatham, MA. More recently, as a result of a recommendation for denial by your New England Division, our respective staff have held telephone conversations about the project. This letter reconfirms our previous written comments on this project.

It is of particular concern to me that, as a result of a wide-ranging discussion amongst our staff, the ACOE has concluded (and is using as a basis for its decision) that the NMFS is concerned about the economic viability of the commercial fishery located at Aunt Lydia's Cove and/or has determined that this fishery will not survive due to the current status of the groundfish and other fishery resources upon which they depend.

Nearly all comments from my staff have concentrated on environmental and protected species questions. The lone exception were some general comments on fish stocks and markets made in response to direct questions from Corps staff during a conference call on May 13, 1992.

Your Agency should understand that this is a fishery of opportunity which historically has sought whatever resource was abundant and in demand and, in my view, will be able to survive economically irrespective of the current status of the groundfish stocks. The harbor at Aunt Lydia's Cove is important to the Chatham fleet due to its location relative to the historical fishing grounds utilized by the fleet and if lost would, no doubt, pose a serious hardship to the fleet and support industries located at the port. The current economic crisis in the New England groundfish fishery is having a serious affect on access for the commercial fishing industry as water-dependent

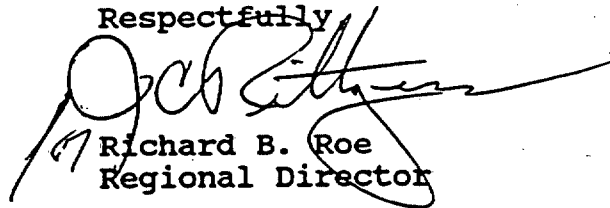


2.

support facilities and vessels themselves are unable to compete against other economic interests. Therefore I believe it is desirable for both the industry located there, as well as the users of the seafood harvested by that fleet, to save the harbor at Aunt Lydia's Cove to the extent possible. I do not believe the current status of the traditional groundfish resources is an economic impediment to the Chatham fleet since not only are there alternative available resources such as lobster but, it being the intention of the New England Fishery Management Council and the National Marine Fisheries Service to rebuild those traditional resources, I would hope there is a surviving industry to reap the benefits of that effort.

Please call me at 508/281-9250 if you wish to discuss the role of my office in this project.

Respectfully

A handwritten signature in dark ink, appearing to read "Roe", is written over the typed name. The signature is fluid and cursive, with a long horizontal stroke extending to the right.

Richard B. Roe
Regional Director



Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Management

August 18, 1992

349 Lincoln Street
Bldg. #45
Hingham
Massachusetts
02043
(617) 740-1600
Fax: 727-2950

**Bureau of
Coastal Engineering**
Office of
Waterways

Ms. Nancy P. Dorn
Assistant Secretary of the Army (Civil Works)
Department of the Army
Office of Assistant Secretary
Washington, DC 20310-0103

Re: CHATHAM - Aunt Lydia's Cove Feasibility Study

Dear Ms. Dorn:

The Chatham Working Committee has provided this office with their comments on the draft Guidance Memorandum for the subject study and I would like to provide you with comment on two items:

Guidance K - Evaluates the alternative use of the
County Dredge:

The County Dredge proposal is currently proceeding and we believe it will be active in the Winter of 1993. The program requires the municipalities to request dredging projects which are fully permitted and funded so an annual program can be established. Their Committee is now evaluating a list of requested projects. Based on this requirement, Chatham could not submit a request until the FY 1994 period.

There are many projects in Barnstable County that would qualify for this program and we anticipate each municipality would be authorized one project for each season and since the current report stipulates as many as three dredging operations in Aunt Lydia's Cove annually, I believe the County Dredge Program could only be considered for one project at Aunt Lydia's Cove annually.

Unless the number of dredging operations is reduced as suggested by the Town in their response to Guidance K, this option could only be a partial solution.

Nancy P. Dorn
Assistant Secretary of the Army (Civil Works)

-2-
August 18, 1992

Guidance P - Recomputing costs of dredging:

We have provided the New England Division with a list of contracts this agency has undertaken over the past years which reflect lower costs and we strongly urge recalculation of costs.

We look forward to continuing cooperation on this project and hope the information provided will be evaluated. It is my opinion that it will provide the benefits which will allow the Corps of Engineers to continue onto the next phase and work with the Commonwealth and the Working Committee to make the necessary improvements to Aunt Lydia's Cove.

Very truly yours,



Eugene F. Cavanaugh
Director

cc: Joseph L. Ignazio,
Director of Planning
Corps of Engineers



Massachusetts Audubon Society

South Great Road
Lincoln, Massachusetts 01773
(617) 259-9500

March 4, 1993

Chris Hatfield
Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Dear Chris:

As per your request, I am responding in writing concerning your question as to whether the Society realizes any financial benefit from the deposition of dredge spoil on our property, Tern Island, Chatham. In short, the answer is NO. The property is solely used in its natural state as a wildlife sanctuary. There are no manmade structures on the island that need protection from erosion.

As we have said in prior letters, we are accepting the dredge spoil to improve the nesting area of threatened species of terns and shorebirds. The Society would not undertake a beach renourishment project to do the same as the cost would be prohibitive.

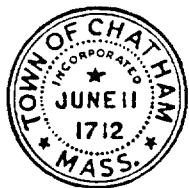
Also per your request, I am writing to revise our figures concerning the elevation of dredge spoil that we would accept on Tern Island. My letter of February 10, 1992, to your agency said: "...to an overall height of approximately fifteen feet above mean low tide..." This was a mistake on my part. Please revise the request to fifteen feet above mean high tide OR change to an appropriate new figure by adding the tidal difference to the 1992 figure. Also, the Society will consider accepting additional dredge spoil in future years that may exceed this new level, if we feel that going beyond the current capacity will not damage the nesting populations of birds at that time.

If you have further questions please don't hesitate to call.

Sincerely,

Scott Hecker, Coordinator
Coastal Waterbird Program

SH:cf



TOWN OF CHATHAM
CHATHAM MUNICIPAL FISH PIER
WHARFINGER — ASSISTANT HARBORMASTER



March 9, 1993

Mr. Joseph L. Ignazio
Director of Planning
New England Division, Corp of Engineers.
4224 Trapelo Road
Waltham, MA 02254-9149

Dear Mr. Ignazio,

This letter is in response to your letter of January 15, 1993 to Mr. Lindstrom. In order to clarify any confusion the Corps of Engineers, New England Division may have in regards to dredging of Aunt Lydia's Cove the following list was compiled:

- (1) 1989, AGM Marine 7,000 cu. yds., 8ft low water, 79,450.
(channel only)
- (2) 1991, AGM Marine 34,850 cu.yds., 8ft low water 186,000.
(channel and mooring basin)
- (3) 1992, Halloween Storm (Oct. 1991) 2,772 yds NE side,
1,595 yds. SE side

Information on material removed regarding shoreside maintenance dredging is not available. The amount of material removed was minimal. This method was used on three occasions in the channel and once in the mooring basin.

If you have any questions please contact me at 945-5186.

Sincerely,

Stuart F.X. Smith,
Wharfinger-Asst. Harbormaster



Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Management

April 20, 1993

100 Cambridge Street
Boston
Massachusetts
02202
(617) 727-3160
Fax: 727-2630

Paul Pronovost, Planning Directorate
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02245-9149

Division of
Resource Conservation

Re: Chatham/Aunt Lydia's Cove Navigation Project

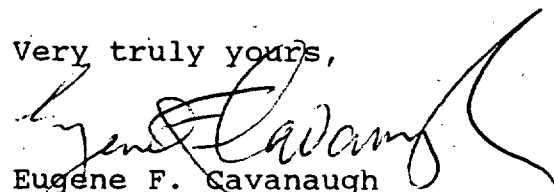
Dear Mr. Pronovost:

In response to a telephone request from Chris Hatfield, Project Manager, we would like to provide an update on the proposed Barnstable County dredge acquisition project. At this time the project is proceeding toward realization, with the hiring by the Barnstable County Commissioners of a consultant to develop the organizational and business aspects of county dredge operation and maintenance.

The consultant is expected to be in place by mid-May, with a business plan developed by early summer. One part of that individual's responsibility is the development of a bid package for dredged acquisition on a lease/purchase basis, as well as recommendations to the County Commission of an equitable basis for town financial participation in dredge operating and maintenance costs.

We will be pleased to keep you informed as this effort progresses, particularly as it may affect the Corps' study for the navigation project at Aunt Lydia's Cove, Chatham. If you have any questions, please do not hesitate to contact me at (617) 727-3160, Ext. 529, or Leslie Lewis, Rivers and Harbors Program, at Ext. 549.

Very truly yours,


Eugene F. Cavanaugh
Director of Waterways

LRL/lrl

APPENDIX 3

CONTRACTED ECONOMIC INPUT

**SUPPLEMENTAL ECONOMIC ASSESSMENT
OF COMMERCIAL FISHING IMPACTS FOR
THE AUNT LYDIA'S COVE
NAVIGATION IMPROVEMENT STUDY**

Prepared for:

Normandeau Associates, Inc.
25 Nashua Road
Bedford, NH 03102

and

New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254

Prepared by:

Industrial Economics, Incorporated
2067 Massachusetts Avenue
Cambridge, MA 02140

May 28, 1993

Contract No. DACW33-92-D-0004

INTRODUCTION

In July of 1992 the New England Division of the Corps of Engineers held a Special Review Conference (SRC) to examine the Section 107 Navigation Study for Aunt Lydia's Cove in Chatham, Massachusetts. The study (referred to here as the 1991 Report) assessed the feasibility of navigation improvements to offset shoaling problems in Aunt Lydia's Cove (ALC), home port to a moderate size commercial fishing fleet. The SRC identified a number of issues in the initial report that require further investigation. These issues are to be addressed in a supplemental information report (SIR) currently being prepared by the Corps' New England Division.

The Corps has asked Industrial Economics, Incorporated (IEc), as a subcontractor to Normandeau Associates, Inc., to investigate and analyze three issues to be addressed in the SIR. This report reviews IEc's findings with respect to these issues. Specifically:

1. The 1991 Report examined the impact that navigation problems would have on the fishing fleet's ability to obtain a premium price for its catch. This report investigates the nature and magnitude of this "freshness premium."
2. The 1991 Report assumed that, in the event that no navigation improvements were pursued, 21 deep draft vessels could relocate to Stage Harbor. This report reviews the validity of this assumption, considering conditions in Stage Harbor and additional options that fishermen with deep draft vessels could pursue.
3. The 1991 Report was criticized for not fully examining the effect of shoaling conditions on the catch of underutilized species. This report considers how the catch of these species could be affected if no navigation improvements are pursued.

It is important to note that, due to time and resource limitations, our investigation of relocation and other potential responses to the no project condition focused exclusively on the deep draft vessels currently operating in Chatham. In the no project condition, the pressure for relocation would be greatest for these vessels since their size would make it more problematic for them to gain access to the fish pier in ALC. Although the operation of shallower draft vessels would also be impaired by shoaling in the no project condition, we implicitly have accepted the assumption in the 1991 Report that these vessels could continue to operate out of ALC. The economic costs imposed by shoaling on vessels that may continue to operate out of ALC (e.g., loss of fishing days due to tidal conditions) were analyzed in the 1991 Report and are reported therein. Because the effects of shoaling on deep draft vessels may have a disproportionately greater effect on the overall economic loss estimate, they are the subject of this review.

As discussed further below, the findings of our research are based on interviews with key individuals (fishermen, seafood marketers and others) and other available data. This research supports the following observations and conclusions:

- ▶ Because of a variety of factors (freshness, fishing method, handling practices), Chatham fish receive a higher market price than do the same species of fish caught in other ports. While estimates offered in interviews vary, this premium probably ranges between \$0.05 and \$0.35 per pound. Data from other sources support the existence of such a premium.
- ▶ In interviews, fishermen and others pointed to a variety of obstacles that would discourage deep draft vessel operators from relocating to Stage Harbor (as was assumed in the 1991 Report). These constraints include a lack of mooring space, inadequate offloading facilities, added steaming time to the fishing grounds, and conditions less conducive to receiving premium prices for fish.
- ▶ As an interim solution to increased shoaling, most deep draft vessel operators indicated that they would skiff their fish to the pier in ALC. When pressed for their long-term response to a no project condition, six of the 15 interviewed said they would leave commercial fishing, while nine said they would be willing to relocate to a nearby port if practical obstacles to relocation were removed (three have already done so).
- ▶ Our research indicates that some of the deep draft vessel operators would leave commercial fishing. We estimate that the annual cost of these deep draft fishermen leaving commercial fishing is between \$66,800 and \$133,500, with a midpoint estimate of approximately \$100,000. This reflects the economic loss associated with the diminished supply of premium-quality Chatham fish; we use the per-pound ex-vessel price premium paid for Chatham fish to estimate these losses.
- ▶ For fishermen expressing a willingness to relocate, we analyze changes in operating costs assuming that they will operate out of Stage Harbor, still the best option relative to ALC. Added annual fuel costs for these vessels would be roughly \$27,000; we estimate the cost of added crew time to be between \$35,000 and \$104,000.
- ▶ For the vessels that relocate, there will be a cost associated with the loss of high-quality Chatham fish (since the added steam from Stage may prompt longer fishing trips or reduced effort). It is, however, extremely difficult to establish the degree to which the catch of prime fish will be reduced. Sensitivity analysis under varying assumptions implies that the economic cost could range from as little as \$2,000 to as much as \$155,000, with a midpoint estimate of about \$78,700.
- ▶ Taken together, the costs associated with the deep draft vessel response to the no project condition range between \$131,000 and \$419,000, with a midpoint estimate of \$275,000.

- ▶ Our analysis of the potential effects of shoaling on the catch of underexploited (or fully exploited) species focuses on lobster, one of the most highly valued species landed at ALC. This analysis suggests that unchecked shoaling at ALC would lead some lobstermen to quit and others to reduce their effort.
- ▶ Decreased effort by ALC lobstermen would reduce their total catch significantly, resulting in a loss of \$432,300 in annual ex-vessel revenues. This loss would be partially offset by a reduction in variable operating costs. In total, we estimate that net income from lobstering would be reduced by \$328,000 to \$380,000 per year.
- ▶ We estimate that the ex-vessel value of landings of other underexploited (or fully exploited) species at ALC is \$400,000 per year. Additional research and analysis would be required to determine how shoaling at ALC might affect the net income associated with the catch of these species.

The remainder of this report is organized as follows:

- ▶ First, we describe our research methodology, discussing the interview process and the questions posed.
- ▶ Second, we examine our findings for the three central issues reviewed above: (1) the nature and magnitude of the freshness premium; (2) the feasibility of relocation to Stage Harbor and the costs that would be incurred by deep draft vessels and society at large; and (3) the effect of shoaling on the catch of underutilized species. We address these topics in three separate sections.

METHODOLOGY

In gathering information for our analysis, we relied primarily on interviews with individuals who either would be directly affected by the navigation improvement project (fishermen) or are involved in the marketing of the Chatham catch. Our objective was to develop a clear understanding of potential outcomes under the no project condition, as well as to understand the marketing aspects of the Chatham fishing industry. Together, we interviewed 45 individuals: 15 active fishermen with deep draft vessels and one retired deep draft vessel operator; 15 other fishermen, including several from ALC who target lobsters, a species that is not considered overexploited; the Chatham Wharfinger; the Chatham and Harwich Harbor Masters; representatives of two fish distributors; the Stage Pier operator; and six fish buyers. Exhibit 1 presents a list of all those interviewed.

Fisherman Interviews

At the outset of our interview recruiting effort we sent a letter to fishermen with deep draft vessels, explaining our objectives and expressing our interest in meeting with them. Once the Chatham fishing community learned of our analysis they requested a meeting to discuss our

approach. On April 12, two IEc representatives met with the ALC Working Committee (consisting of fishermen and town officials) and Corps representatives to discuss the purpose of our analysis and our proposed methodology (i.e., individual interviews). Once briefed, the Working Committee approved our approach.

IEc then proceeded to contact fishermen by phone to arrange interviews. We conducted the majority of the interviews between April 14 and April 21, 1993. We performed most of the interviews at the fishermen's homes or the house from which we operated in Chatham. Other interviews took place on the pier or by telephone when a meeting was not feasible. The interviews lasted between 45 minutes and two hours.

The questions asked of fishermen fall into three general categories. The first set of questions focused on background issues regarding fishermen's vessels and gear (e.g., draft of the vessel, crew size, type of gear). The second category consisted of questions regarding their fishing practices (e.g., what species they target, their average catch, average steaming time to the fishing grounds). The third category consisted of questions regarding their mooring situation and their options in the face of a no project condition. Appendix A presents the guide we used in conducting these interviews, identifying key questions and general areas of inquiry. Because we relied on informal interviews rather than a formal survey, we did not strictly adhere to the order or wording of questions presented in the guide.

Other Interviews

To improve our understanding of the marketing of the Chatham catch and to corroborate information from fishermen, we spoke to a number of other individuals involved in commercial fishing. First, we spoke with fish distributors and brokers in Chatham (Chatham's Finest, Chatham Fish and Lobster, and the pier operator in Stage Harbor). In addition, we spoke to two fish buyers in Boston (one in person and one by phone) and four fish brokers at New York's Fulton Fish Market. Most of these interviews took place between April 26 and April 30, 1993 (see Exhibit 1).

The questions asked of fish distributors and buyers focused on the price premium purportedly awarded to Chatham fish. Specifically, we investigated whether Chatham fish command a premium on the market, probed the rationale for this premium, and attempted to determine the magnitude of the premium.

Analytic Approach

As described below, the interviews provided a complex collection of observations that often were difficult to reconcile. Therefore, to arrive at estimates of the potential economic losses in the no project condition, we combined information gathered in interviews with available data and professional judgment. While this often yields wide-ranging estimates of economic impacts, we feel that this variation appropriately reflects the level of uncertainty surrounding the estimates.

Exhibit 1
INDIVIDUALS INTERVIEWED

Name	Date Interviewed	Interview Type
Deep Draft Fishermen		
Amara, Bill	4/20/93	in-person
Armstrong, Christopher	4/15/93	in-person
Bloomer, Kenneth	4/14/93	in-person
Brown, Thomas (Nick)	4/14/93	in-person
Cole, Peter	4/15/93	in-person
Farnham, Mark	4/16/93	in-person
Halfacre, Robert	4/15/93	in-person
Hansen, Mark	4/14/93	telephone
McMullen, Alan	4/20/93	in-person
Melbye, Charles	4/22/93	telephone
Our, John	4/19/93	in-person
St. Pierre, Robert	4/19/93	in-person
Sweeney, Brian	4/19/93	in-person
Tolley, Kenneth	4/14/93	in-person
Tolley, Stuart	4/16/93	in-person
Tolley, Walter Jr.	4/15/93	in-person
Other Fishermen		
Anderson, Michael	4/21/93	in-person
Basset, Herbert Jr.	4/23/93	telephone
Belsito, Gene	4/15/93	in-person
Berquist, Paul	4/21/93	in-person
Dickert, Tom	4/20/93	in-person
Hyora, Nick	4/16/93	in-person
Koski, John	4/16/93	in-person
Koziak, Steve	4/20/93	telephone
O'Connor, James	4/26/93	telephone
Pickard, Terry	4/20/93	in-person
Ryder, Michael	4/16/93	in-person
Ryder, Robert	4/21/93	in-person
St. Pierre, Norm	4/19/93	telephone
Tallman, Brad	4/21/93	in-person
Tuttle, John	4/21/93	in-person
Other		
Allen, Art (Chatham Fish and Lobster)	4/30/93	telephone
Carnes, Dave (Chatham Fish and Lobster)	4/14/93	in-person
Fogliano, Frank (Fair Fish - Fulton)	4/30/93	in-person
Ford, Peter (Chatham Harbor Master)	4/28/93	telephone
Idaspe, Nick (Wallace, Keaney, & Lynch - Fulton)	4/30/93	in-person
Jones, Richard (Jones Sea Products, Inc.)	4/27/93	in-person
Kelley, Scott (Chatham's Finest)	4/23/93	telephone
Leach, Tom (Harwich Harbor Master)	4/20/93	in-person
Payne, Bob (Chatham's Finest)	4/22/93	telephone
Scolla, Paul Jr. (Roland & Paul, Inc.)	4/28/93	telephone
Simonitsch, Mark (Stage Pier Operator)	4/19/93	in-person
Smith, Stuart (Chatham Wharfinger)	4/14/93	in-person
Tatick, Vinnie (Jos. Carter - Fulton)	4/30/93	in-person
Tortorice, Richard (Caleb Haley - Fulton)	4/30/93	in-person

**QUESTION 1: WHAT IS THE NATURE AND MAGNITUDE OF THE
PRICE PREMIUM AWARDED TO CHATHAM FISH?**

The Special Review Conference requested that the Corps: (1) review the validity of the "freshness factor"; and (2) estimate the lost revenue in the no project condition due to loss of this price premium. IEc interviewed various key individuals (fishermen, distributors, and brokers) and reviewed available data in an attempt to verify and characterize the premium paid for Chatham fish. In this section, we review the results of this inquiry. In the following section, we use information on the magnitude of the premium to assess the economic losses that fishermen and society in general would experience if fishermen leave commercial fishing or relocate to a port other than ALC.

Shoaling conditions at ALC may adversely affect the prices Chatham fishermen receive in two ways: (1) loss of the premium paid for Chatham fish as a result of their freshness and intrinsic features; and (2) the potential loss of the price premium paid for fish marketed in New York. From a regional and national perspective, however, only the former is a true economic cost. The rationale for this distinction is explained more fully below.

The Chatham "Freshness Premium"

Interviews and price data confirm that, for the principal groundfish species landed in Chatham, Chatham fish receive a higher price than fish landed at other ports. This premium is a function of a variety of complex factors, including:

- ▶ **Freshness:** The elapsed time from when a fish is hooked or netted to when it is sold has implications for the price paid. Fresh fish command a higher price, both at the pier and at the market. As noted in the 1991 Report, fishermen operating out of ALC enjoy quicker access to fishing grounds than do fishermen working out of other ports. This allows fishermen to deliver fish to the pier in limited time (one or two days).
- ▶ **Fishing Method:** The method by which a fish is caught directly affects the price received. Those interviewed generally agreed that hooked fish (longlined or jigged) are superior to fish caught by other methods since they are still alive when hauled. According to those interviewed, gillnetted fish can receive a price premium if nets are not set for long periods of time (i.e., over two days) and if the fish are handled properly once on board (e.g., thoroughly iced). In general, however, it is more difficult for gillnetted fish to receive as high a price as hooked fish because the fish drown after they are netted, and can soften in the water; in addition, when gillnetted fish struggle in the nets, they can become bruised.¹ In general, dragged fish command a lower price than fish caught by other methods, although dragged fish can also receive some premium if they are brought to port promptly.

¹ Several fishermen also noted that in the course of struggling, a gillnetted fish releases a chemical that degrades the quality of the fish. Others interviewed disputed this theory.

- ▶ **Handling:** How fish are handled once caught affects the price received for the fish. Chatham fishermen make shorter fishing trips (generally one to two days) and therefore haul more limited loads to the pier (typically 1000 to 2000 pounds). This allows the fishermen to carefully ice the fish, and in some cases dress the fish before reaching the pier. This contrasts with the practices of larger vessels that fish longer trips; these vessels store fish in large holds where heat and pressure (from stacking) can damage the fish. Buyers interviewed noted that Chatham fish have a reputation for being handled carefully.
- ▶ **Intrinsic Quality:** Although difficult to separate from other factors, several sources interviewed noted that Chatham fish have desirable qualities independent of freshness, fishing method, or handling. Because their feeding grounds are flushed by currents, the fish tend to be relatively free of worms that more frequently infest fish caught elsewhere and landed at other ports.² Furthermore, because they are hauled promptly, the fish tend to be free of fleas that infest fish that soak in nets for long periods of time.

Chatham fish can be marketed in several ways. ALC fishermen typically sell to Chatham's Finest and Chatham Fish and Lobster, the two distributors who lease offloading and fish packing facilities at the ALC fish pier. These distributors then sell to fish brokers in Boston, New York, and other markets who in turn sell to retailers (markets, restaurants) where fish are processed for sale. Alternatively, fish may be sold directly to processors; this is the case in Stage Harbor, where fishermen using the private fish pier sell to North Coast Seafoods (see discussion below). Processors typically fillet the fish and sell to large retailers (e.g., supermarkets, frozen food companies).

Whatever market path is followed, prices for fish are set on a daily basis and are heavily influenced by buyers' evaluations of fish quality. These evaluations take into account the factors noted above (and other factors) to determine the premium that will be paid for Chatham fish. As a result, there is no simple way to attribute a specific premium to any single one of the factors noted above. For example, we asked fishermen and fish marketers whether a gillnetted cod can receive the premium price that would be awarded to a longlined cod. The interviewees felt that this depended on the time that the gillnets were soaked; i.e., a one-day gillnetted fish could receive the same price that a two-day longlined fish might receive. Overall, there is no set premium paid for Chatham fish. Instead, the premium received depends upon the combination of various factors considered by fish buyers; Chatham fish simply tend to rate favorably on these various factors.

While the nature of the price premium is complex, available information suggests that such a premium does indeed exist. We can develop estimates of the magnitude of this premium based on available data and interviews with fishermen and fish marketers. The Cape Cod Times publishes data on fish auction prices in Boston, New York, and New Bedford. Market data from New York frequently show prices for Chatham steak cod relative to steak cod from other locations sold on the same day. Exhibit 2 shows a sample of these data, randomly selected from the past year. In all cases, the price paid for Chatham cod is greater, on average by about \$0.25. In percentage terms, the difference is roughly 13 percent.

² Some sources indicated these worms may be attributable to seal feces.

Exhibit 2
PRICING DATA FOR STEAK COD SOLD IN NEW YORK*

	Chatham Price	Prices for Other Locations				Price Differential	Percentage Differential
		NYC	Maine	NY (LI)	P-town		
1	2.25	2.00				0.25	12.5%
2	2.25		1.75			0.50	28.6%
3	2.25		2.00			0.25	12.5%
4	2.25				2.00	0.25	12.5%
5	2.25				2.00	0.25	12.5%
6	2.25			2.00		0.25	12.5%
7	1.90				1.75	0.15	8.6%
8	2.00		1.73			0.27	15.9%
9	1.60		1.43			0.17	11.9%
10	1.75		1.63			0.12	7.4%
11	2.75		2.50			0.25	10.0%
					Average:	0.25	13.2%

* Source: Cape Cod Times, randomly selected days in 1992 and 1993.

These data are fairly consistent with comments from fishermen and fish marketers. Fish marketers in Boston and New York indicated that Chatham fish will receive anywhere from \$0.05 to \$0.35 more per pound than fish from other ports, depending upon the species.³

As described below, this price premium plays an important role in estimating economic losses in the no project scenario. If consumers could no longer obtain prime Chatham fish due to reduced landings in Chatham or a reduction in the quality of landings, the loss could be roughly valued as the premium awarded to these fish above and beyond the price paid for lesser-quality fish. This assumes that the overall fish catch would not change, but that fish of the quality currently brought to ALC would not be available.

Note, however, that economic losses for society at large should not be equated with economic losses for fishermen. The premium noted above (\$0.05 to \$0.35) reflects the difference in final selling price, not the difference in ex-vessel price. The ex-vessel differential will be smaller since prices increase at each level of sale (i.e., distributors and brokers). National Marine Fisheries Service data on ex-vessel prices verify that prices paid to fishermen in Chatham generally exceed the statewide average price, but to a lesser degree than the differential in final selling price.⁴ Hence, economic losses for fishermen are smaller than total economic losses that may be realized in society at large. According to benefit evaluation procedures used by the Corps, the economic losses realized by Chatham fishermen (which are not transferred as gains to other fishermen) are the costs to be considered in developing a benefit/cost assessment of navigation improvements to ALC. Since the exact premium paid at the ex-vessel level is unknown, the analysis discussed in the next section of this report uses one half of the full market price premium as the estimate of the ex-vessel premium (i.e., we use the range of \$0.025 to \$0.175 per pound to estimate economic losses).

Effect of Marketing Location on Price

A portion of the fish caught in ALC are sold at the Fulton Fish Market in New York City. This percentage varies over time depending on price patterns. A representative of Chatham Fish and Lobster pointed out that recently, New York prices have tended to vary significantly depending upon the quality of the fish, a practice that works in Chatham's favor. In contrast, Boston markets tend to treat fish equally, awarding the same price to all fish. Therefore, Chatham has recently been sending approximately two-thirds of its fish to New York.

In interviews, fishermen noted that access to the New York market is important since prices paid in New York are generally greater than prices paid in Massachusetts markets (e.g., Boston, New Bedford). Interviews with fish marketers in Boston and New York verified this price differential. Those interviewed indicated that, for a given fish, the New York price would exceed the Boston

³ The price differential for steak cod may be larger than the differential for other species due to the overall higher price.

⁴ For purposes of this analysis, IEC obtained catch and price data for fish landed in Chatham from the National Marine Fisheries Service (NMFS). NMFS considers this information confidential; as such, Federal criminal statutes, the Trade Secrets Act, and the Magnuson Act prohibit its disclosure.

price by roughly 10 to 20 percent (\$0.10 to \$0.20 on a \$1 finfish). Price data published in the Cape Cod Times verifies such a premium, and suggests that it may be even larger. Exhibit 3 shows the difference in prices for five market categories of fish, as recorded throughout the past year. As shown, for categories where a large number of observations are available (dabs and sole), New York prices exceed Boston prices by about 10 to 30 percent (\$0.10 to \$0.30 on a \$1 finfish).

Because New York prices tend to be higher, reduced access to New York markets could result in lost revenue for Chatham fishermen. On a per pound basis, this revenue loss will be less than the actual market price differential since distribution and brokerage of the fish will add to the final cost. Theoretically, it is possible that the price differential is attributable to shipping costs alone, such that the ex-vessel prices awarded to fishermen do not vary. Fishermen did state, however, that the ex-vessel price will be greater for fish that are to be marketed in New York.

Note that although Chatham fishermen's revenues would decline if their access to the New York market were reduced, this decline would not constitute an economic loss from a regional or national perspective, provided that fish from other ports would reach the New York market and meet its demand. If these substitute fish are of lesser quality, the economic loss is accounted for by the premium paid to Chatham fish because of their intrinsic quality (see above). Stated differently, there is no social loss because fishermen from some other port would receive the higher New York price. Because the price premium paid in New York would be transferred to other fishermen, we do not consider it in analyzing the regional or national economic costs of the no project condition at ALC.

QUESTION 2: HOW WOULD THE 21 DEEP DRAFT VESSELS RESPOND IN THE NO PROJECT CONDITION?

The 1991 Report assumes that under the no project condition, the increased shoaling in ALC would impede the passage, at all tidal ranges, of those boats with the deepest drafts.⁵ Of the 69 boats identified in that report as having permits to offload their catch at the pier, 19 are currently active and have drafts ranging from four and a quarter to seven feet.⁶ The lack of a project would therefore preclude these 19 vessels from operating out of ALC. In the 1991 Report, the Corps assumed that these vessels would relocate to Stage Harbor and that their overall catch would remain the same.

The main implication of this assumption in the Corps' report is the added time needed to get to and from the fishing grounds. In general, the Corps assumed that each vessel would steam between one and a half to two additional hours each way.⁷ In the 1991 Report, the Corps calculates two categories of costs attributable to this added steaming time.

⁵ Deep draft vessels are defined as those having loaded drafts greater than four feet.

⁶ The 1991 Report identified 21 deep draft vessels. The draft on one of these vessels, Genesis, was incorrectly measured, overestimating the draft; this vessel is not considered in our analysis. The operator of another vessel, the Wee John III, has retired for reasons unrelated to the shoaling in ALC. This reduces the number of vessels of interest to 19.

⁷ The additional steaming time reflects the need to steam south to Monomoy Point, northeast through Pollock Rip Channel and out to the fishing grounds.

Exhibit 3
FISH PRICE COMPARISON BETWEEN NEW YORK AND BOSTON*

Date	Cod (large)				Cod (market)				Dabs (large)				Grey Sole (large)				Grey Sole (medium)			
	NY	Boston	Diff	% Diff	NY	Boston	Diff	% Diff	NY	Boston	Diff	% Diff	NY	Boston	Diff	% Diff	NY	Boston	Diff	% Diff
02/19/92													2.50	3.55	(1.05)	-29.6%	2.50	2.68	(0.18)	-6.7%
03/10/92									2.23	1.40	0.83	58.9%	3.75	3.00	0.75	25.0%	2.25	2.25	0.00	0.0%
03/11/92									2.00	1.44	0.56	38.9%	2.50	2.75	(0.25)	-9.1%	2.00	2.00	0.00	0.0%
03/12/92	1.73	1.20	0.53	43.8%					1.90	1.48	0.44	30.1%								
03/13/92									1.78	1.38	0.41	30.5%	2.75	2.50	0.25	10.0%	2.25	1.71	0.54	31.6%
04/01/92													3.00	3.00	0.00	0.0%				
04/07/92									2.25	2.00	0.25	12.5%					2.25	1.80	0.45	25.0%
04/08/92									2.25	2.00	0.25	12.5%					2.25	2.21	0.04	1.8%
04/10/92									2.28	1.75	0.53	30.0%								
04/14/92													3.25	3.25	0.00	0.0%				
04/15/92					1.40	1.05	0.35	33.3%												
05/01/92									1.28	1.04	0.23	22.6%	3.00	2.36	0.64	27.1%				
05/05/92									1.38	0.90	0.48	52.8%	2.50	2.25	0.25	11.1%	2.00	1.35	0.65	48.1%
05/08/92									1.40	1.12	0.28	25.0%								
05/12/92									1.50	1.18	0.32	27.1%	3.48	3.40	0.08	2.2%	2.90	2.25	0.65	28.9%
05/13/92									1.58	1.30	0.28	21.2%	3.75	3.25	0.50	15.4%	2.60	2.30	0.30	13.0%
05/14/92	1.63	0.85	0.78	91.2%					1.63	1.40	0.23	16.1%								
05/15/92									1.60	1.40	0.20	14.3%								
06/02/92									1.00	0.73	0.27	37.0%	2.25	1.55	0.70	45.2%				
06/04/92									1.08	0.65	0.43	65.4%	1.28	1.70	(0.43)	-25.0%				
06/12/92									1.33	1.00	0.33	32.5%	2.40	2.01	0.39	19.4%	1.70	1.30	0.40	30.8%
07/01/92									1.40	1.00	0.40	40.0%	3.30	2.65	0.65	24.5%				
07/02/92									1.23	1.00	0.23	22.5%	3.25	2.40	0.85	35.4%				
07/08/92									1.43	1.19	0.23	19.7%	2.65	3.25	(0.60)	-18.5%				
07/09/92									1.53	1.25	0.27	22.0%	3.75	3.00	0.75	25.0%	2.00	1.98	0.02	1.0%
07/10/92									1.53	1.16	0.37	31.5%								
07/14/92									1.50	1.08	0.44	41.5%								
07/15/92									1.60	1.15	0.45	39.1%	3.25	3.01	0.24	8.0%				
07/16/92									1.28	1.10	0.17	15.9%	3.00	3.00	0.00	0.0%	2.25	2.00	0.25	12.5%
07/17/92									1.40	1.18	0.22	18.6%								
07/28/92													3.25	2.85	0.40	14.0%	2.60	1.95	0.65	33.3%
07/29/92													3.25	2.20	1.05	47.7%	2.60	1.61	1.00	62.0%
07/30/92									1.23	1.05	0.18	16.7%	3.75	2.80	0.95	33.9%				
07/31/92									1.33	1.10	0.23	20.5%								
08/14/92									1.50	1.20	0.30	25.0%	2.75	2.66	0.09	3.4%	2.40	1.60	0.80	50.0%
09/01/92					1.60	1.19	0.41	34.5%												
10/01/92									1.30	1.36	(0.06)	-4.4%	3.25	3.15	0.10	3.2%	2.00	2.36	(0.36)	-15.3%
10/15/92									1.35	0.92	0.43	46.7%	2.85	3.00	(0.15)	-5.0%	1.50	2.00	(0.50)	-25.0%
11/03/92									1.40	1.02	0.38	37.3%	2.75	2.75	0.00	0.0%				
11/13/92									1.33	0.90	0.43	47.2%	2.75	2.60	0.15	5.8%	2.25	1.95	0.30	15.4%
12/01/92									1.73	1.00	0.73	72.5%	2.50	2.30	0.20	8.7%				
01/06/93									1.63	1.36	0.26	19.5%								
01/15/93									1.63	1.35	0.27	20.4%								
02/02/93													3.60	3.24	0.36	11.1%				
02/17/93													3.50	2.51	0.99	39.4%	2.75	1.91	0.84	44.0%
Average:	1.68	1.03	0.65	67.5%	1.50	1.12	0.38	33.9%	1.55	1.21	0.34	30.0%	2.99	2.73	0.26	10.9%	2.27	1.96	0.31	18.4%

* Source: Cape Cod Times; randomly selected days in 1992 and 1993.

- ▶ First, the added steaming translates directly into added fuel costs for each trip. This additional consumption of resources to maintain the same fishing catch represents a net increase in harvesting cost.
- ▶ Second, the additional time spent by fishermen and their crew steaming to the fishing grounds represents an opportunity cost that must be taken into account.

Interviews with fishermen suggest that the assumption that fishermen with deep draft vessels can readily relocate to Stage Harbor or to other ports is a simplification. In fact, there are several other options available to them. In interviews, we asked fishermen to focus on three additional options: (1) continuing operations out of Chatham Harbor, perhaps by skiffing their catch to the ALC fish pier; (2) leaving commercial fishing; and (3) switching to a shallow draft vessel.

The first alternative is to stay in ALC (or the outer harbor) as long as possible. As the shoaling worsened and passage to ALC became impossible for the deep draft vessels, fishermen with moorings in ALC might move them outside of Tern Island and resort to skiffing their catch and fuel (some are doing so already). Some of the fishermen interviewed indicated that they would pursue this option in the interim while they found a more permanent solution (e.g., a mooring in Stage Harbor).⁸

Another possible response to the no project condition is to leave commercial fishing. For instance, some of the fishermen may be close to retirement and would not want to confront either the increased shoaling or the demands of relocating to Stage Harbor. Similarly, some fishermen with promising alternative business prospects may decide to pursue these.

The third alternative open to fishermen with deep draft vessels is to invest in a vessel with a shallower draft. Fishermen indicated, however, that this option is not feasible for two reasons. First, most of the fishermen interviewed felt that any vessel with a draft of less than three and a half to four feet would be dangerous in the open sea. This was particularly true for fishermen who need fairly large vessels to accommodate their gear. Second, most fishermen indicated that the market value for their boats tended to be significantly smaller than the replacement cost.⁹ Given the large upfront costs of investing in a new vessel, most fishermen dismissed this option.

We interviewed 15 out of the 19 active fishermen with deep draft vessels. In these discussions, we attempted to address the central question regarding what they would do under the no project condition. In some cases, the open-ended questions were answered with fairly specific answers. In other cases, the fishermen had not closely considered their options. In these cases we probed certain options, presenting each one separately and asking the fishermen what alternative they would choose.

⁸ The extent to which fishermen will pursue this option depends on the degree and pace of the shoaling.

⁹ Some fishermen suggested that selling their boat would be difficult because their boats are designed to fish out of Chatham (i.e., small boats that can hold a day's catch) and would not be useful in other ports.

In order to develop conclusions regarding the economic implications of fishermen's actions under the no project condition, we developed broad categories of options that the fishermen might pursue. We found that, in the absence of a navigation improvement project, many of the fishermen currently in ALC would stay in ALC as long as possible, playing the tides and/or skiffing their catch and fuel. However, they tended to perceive this as only an interim solution, and ultimately would choose between two potential long-run alternatives. Based on their responses, we estimate that:

- (1) Eight fishermen would cease commercial fishing or dramatically alter their fishing operation; and
- (2) Eleven fishermen would attempt to relocate their vessels to Stage Harbor or to some other nearby port. As described below, their ability to do so may be constrained by the limitations of these alternative ports.

In each of the following three subsections we present details of our conversations with fishermen, the rationale they provided, and the economic analyses we develop based on interviews and other available information.

Stay in ALC as Long as Possible (Interim Solution)

Our interviews identified four active deep draft fishermen (one of whom has switched to oystering) that no longer operate out of ALC (see discussion below); 15 active deep draft vessels remain. Should shoaling worsen in the absence of navigation improvements, many of these indicated that until they found a permanent solution, they would either play the tides or resort to skiffing their catch to the pier and fuel to their boat. Indeed, some fishermen already do so on a regular basis. It is unclear, however, how many fishermen would pursue this option and for how long. Consequently, we provide an illustrative range of the likely short-run costs incurred due to the shoaling problems in ALC.

The primary cost implication of this strategy is an increase in time spent skiffing fish and fuel. The economic loss is represented by the opportunity cost of the additional time spent skiffing. Exhibit 4 presents a simple analysis of the cost implications.

Exhibit 4						
COST IMPLICATIONS OF SKIFFING CATCH AND FUEL						
Estimate	Crew Size	Additional Hours	Trips Affected	Value of Time Per Hour	Typical Annual Cost per Vessel	Annual Cost for Deep Draft Vessels
Lower	2	1	64	\$3.92	\$501	\$7,515
Upper	3	2	64	\$11.75	\$4,512	\$67,680

To estimate the range of short-run costs, we assume that crew size (including the vessel operator) varies between two and three people and that the additional time spent due to skiffing is between one and two hours. Furthermore, we assume that the shoaling would prevent deep draft vessels from entering ALC three-fourths of the time.¹⁰ Consequently, a fisherman will have to use a skiff on three-fourths of the 85 trips he makes each year.¹¹ Multiplied together, these figures indicate that skiffing causes the crew of a typical vessel to spend an additional 128 to 384 hours each year. The Corps requested that we value this added time in two ways. In the upper bound, we evaluated the cost of this added time at the full manufacturing wage rate (\$11.75 per hour, from the 1991 Report); in the lower bound, we use one-third of the full manufacturing wage (\$3.92 per hour). Using these assumptions, we estimate the typical annual cost per vessel to be between \$501 and \$4,512. Assuming that this applies to the 15 deep draft fishermen who currently operate out of ALC, the total opportunity cost incurred by these fishermen would be between \$7,515 and \$67,680.

We emphasize that these costs provide an illustration of the short-run costs under the no project condition. The following sections present the longer-run cost implications as the deep draft vessel operators pursue more permanent options.

Leave Commercial Fishing

Fishermen who would leave commercial fishing in Chatham fall into two categories. The first category consists of older fishermen who would retire, while the second category consists of younger fishermen who would either leave commercial fishing altogether or relocate their vessels outside of Massachusetts. The economic costs of the no project condition are calculated in the same way for both categories.

We interviewed two fishermen who said that in the absence of navigation improvements to ALC, they would retire.¹² One of these fishermen is semi-retired and the other is ready to retire. These fishermen do not care to deal with the added trouble of fishing out of ALC. If they remain at ALC, they would need to skiff their catch regularly. Both indicated that skiffing their catch on a regular basis would be too exhausting and dangerous. Alternatively, these fishermen could relocate to Stage Harbor. However, these fishermen are day fishermen. Relocation to Stage Harbor would result in a significant increase in their steaming time. Faced with these conditions, these two fishermen indicated that they would leave commercial fishing altogether.

¹⁰ Since this is an interim solution and would be used in the short-run, we use a number that falls between what most deep draft fishermen currently face (they need at least half-tide to get in to the pier) and what is projected to happen (no passage at all). Most of the skiffing would take place during the peak fishing season (i.e., summer and early fall) because fishermen want to fish as often as possible.

¹¹ The Corps calculated that the average number of trips per year for the ALC fleet is 85; 1991 Report, pp. 1-13.

¹² As indicated above, a third deep draft fishermen interviewed has already retired for reasons unrelated to the shoaling in ALC, and is excluded from our analysis.

We also interviewed four other fishermen who said that in the absence of navigation improvements to ALC they would leave commercial fishing or otherwise drastically alter their fishing efforts. One of these fishermen has already sold his vessel due to conditions in ALC, though he continues to do some oystering in Oyster River. The second of these fishermen indicated that he fishes out of Chatham because it is a pleasant career. This fisherman's quality of life would be reduced if he had to deal permanently with the shoaling in ALC or relocate to Stage Harbor. Therefore, he would pursue other promising business prospects in Chatham. The third fisherman in this category relocated his vessel to a different state last winter and indicated that he made approximately \$6,000 more than he would have had he stayed in ALC. In addition, this fisherman also has promising business prospects outside of commercial fishing. Given this situation, it is unlikely that this fisherman would remain in ALC or relocate to a nearby port. The last fisherman simply indicated that he would go out of business if he could not operate out of ALC.

At the local level, these early retirements from commercial fishing will likely decrease the catch landed at Chatham. From a national perspective, the economic loss to commercial fishing depends upon whether fishermen from other ports will be able to catch the quantities of fish that may be lost to the Chatham fleet, and whether the quality of these fish when brought to market is comparable to their quality had they been landed by the Chatham fleet. All of those who said they would leave the regional fishery target species (e.g., cod and pollock) that the National Marine Fisheries Service (NMFS) considers over-exploited due to over development of fishing capacity in the Northeast. This excess capacity makes it likely, as the Corps' Guidance Memorandum for the SIR assumes, that existing fleets from other ports in the region will be able to catch the quantities of fish that may be lost to the Chatham fleet. As described above, however, Chatham Harbor's location and the nature of their fishing practices enable Chatham fishermen to land fish of prime quality. Because fishermen from other ports do not enjoy the same proximity to the fishing grounds and do not as commonly employ the same fishing and handling methods as Chatham fishermen, it is unlikely that fish they land would command the premium price paid for Chatham fish. From a national perspective, this loss in quality represents a true economic loss.

We estimate the annual economic loss by calculating the number of pounds of fish caught each year by these fishermen and multiplying this number by the price premium that is foregone as a result of ALC fishermen ceasing their fishing operations.¹³ To calculate the pounds of fish caught each year by these fishermen, we multiply the number of days fished times the average daily catch for each vessel. The six fishermen we interviewed provided estimates of the number of days they fish per year. The two fishermen we did not interview but who were apportioned to this category are assumed to fish 128 days each year.¹⁴ In estimating the foregone catch, we attempted to use catch data supplied by the fishermen. However, we found that the total estimated catch for all deep

¹³ We interviewed six fishermen who indicated that they would leave commercial fishing or dramatically alter their fishing operations. Extrapolating from these results, we assume that two of the four fishermen with whom we did not speak would pursue this option. While we rely only on the six fishermen's descriptions of why they would leave commercial fishing, we include the additional two in calculating the overall costs of the reduction in fishing effort.

¹⁴ This estimate is based on the average of 85 trips per year calculated in the 1991 Report, but assumes an average trip length of 1.5 days (i.e., an equal mix of one-day and two-day trips), which is consistent with overall activity of the fishermen interviewed.

draft vessels would exceed the total amount of fish packed in ALC in 1992. Because this figure was implausibly high, we use the average catch figure from the 1991 Report (1,100 pounds) for all vessels.¹⁵ Based on these figures, we estimate that the total catch foregone each year due to these eight fishermen leaving the commercial fishing industry in Chatham is 1,335,400 pounds. Multiplied by the estimated ex-vessel price premium this catch commands when landed by Chatham fishermen (\$0.025 to \$0.175), the total economic loss of having these fishermen leave commercial fishing would be between \$33,385 and \$233,695, with a mathematical midpoint of about \$133,500. This assumes, however, that all the fish caught by these fishermen currently receive the premium price. Because many factors affect whether a fish is of premium quality, and because fishermen have varying profiles with respect to these factors, only a subset of the catch would be likely to receive the premium. If we assume that one half of the fish caught receive the premium price, the economic costs are likely to be between \$16,693 and \$116,848, with a mathematical midpoint of \$66,800.¹⁶

The economic costs of the no project condition would be counter-balanced to some extent by the reduction in fishing costs attributable to the eight Chatham fishermen leaving the commercial fishing industry. If the increase in costs incurred by other fleets to catch the quantity of fish previously caught by these fishermen were less than the Chatham fishermen's costs, the overall fishing effort would become more efficient. This may be the case, since rival fleets often fish the same grounds the Chatham fleet fishes and do so on a much larger scale. Competing vessels from ports like New Bedford tend to be much larger and go out for a week at a time, returning with a much larger catch. Moreover, many of these competing vessels are draggers, and may be able to catch what the Chatham fishermen previously caught with relatively little additional effort. We have insufficient information, however, to come to defensible conclusions regarding any actual differences in fishing costs, and therefore are unable to include such an estimate in our analysis.

In addition to the change in cost associated with catching the fish, the cost of transporting the fish to market may change when the eight Chatham fishermen leave the industry. It is difficult, however, to estimate how this transportation cost will change since it depends upon the port at which the fish would be landed and the market to which they would be taken. For example, if the fish formerly caught by these Chatham fishermen are caught by draggers operating out of Provincetown, the cost of transporting the fish to markets in New Bedford may increase (due to the added shipping distance). If the fish are landed in New Bedford and then transported to New York City, however, costs could decrease (due to reduced shipping distance). Overall, because it is difficult to predict where the fish would be landed, we are unable to estimate the shipping costs required to bring the fish not landed by ALC fishermen to market.

¹⁵ This figure (1,100 pounds) represents the average per-trip catch used in the 1991 Report. While using this figure as an estimate of daily catch for trips that exceed one day could overstate total annual catch, we should note that: (1) the original figure was based on vessels conducting predominantly day fishing, such that daily catch and per-trip catch were roughly equivalent; and (2) fishermen's estimates of daily catch, both in our research and in the Harbor User Survey conducted for the 1991 Report, are actually somewhat higher than this figure. On balance, 1,100 pounds appears to be a reasonable estimate of average daily catch.

¹⁶ Note that these annual costs reflect losses that would be incurred based on the current size of the fleet in ALC. In the long run, regulatory changes and other circumstances could lead ALC fishermen to leave the industry. The annual benefits of navigation improvements in ALC may be less than those shown here if exogenous factors reduce the size of the commercial fishing fleet over time.

Relocate to Stage Harbor

Deep draft vessel operators mentioned relocation most frequently as the option they would pursue if no navigation improvements took place in ALC. Specifically, three fishermen already operate out of Stage Harbor year-round and six others indicated that they would consider relocation. Almost uniformly, however, these fishermen expressed doubts over the feasibility of relocation, both in light of conditions in Stage Harbor and other alternative ports, and in light of the added operating costs they would experience. Therefore, the following discussion first reviews the constraints that may discourage most vessels from relocating to Stage. We then examine what the cost would be if these constraints were loosened or removed and the remaining deep draft vessels from ALC were able to operate out of Stage.

Constraints Associated with Stage Harbor and Harwichport

Fishermen and others interviewed noted a variety of drawbacks to relocation of commercial fishing vessels to Stage Harbor and Harwichport, located to the west of Chatham. We review these constraints below.

Mooring Space

Potentially the most significant constraint associated with relocation to Stage Harbor is the lack of readily available mooring space. As noted in the 1991 Report, Stage Harbor is dominated by pleasure craft and allots only limited space to commercial fishing vessels. In the summer months, the harbor is said to be cramped, although many of the recreational vessels pull out for the winter. The Chatham Wharfinger indicated that there currently is a 56-person waiting list for moorings in Stage Harbor. This list includes a mix of recreational and commercial vessels. The Chatham Harbor Master noted that it typically takes years to obtain a Stage mooring, and that it may be particularly difficult for the deep draft vessels to secure space since they are large and only a limited set of moorings for large vessels are available. The Harbor Master also indicated that it is not possible to give special consideration to commercial fishing vessels. Moorings are awarded on a first-come-first-serve basis, with consideration given to the size of the vessel and other factors that may make a given mooring appropriate, but there is no discrimination between commercial and recreational vessels. Special consideration may prompt lawsuits from recreational vessel owners waiting for mooring space.¹⁷

Fishermen who have successfully relocated to Stage note that their mooring arrangements are not optimal. North Coast Seafood, in conjunction with the operator of the private fish pier in Stage Harbor. (Mark Simonitsch), owns several moorings in Stage which it currently rents to

¹⁷ Note that commercial vessels from ALC other than deep draft vessels have already relocated to Stage Harbor, as reported in responses to the questionnaires distributed for the 1991 Report. These vessels tend to be smaller and faster than the deep draft vessels, reducing the effect of increased distance on steaming time to the fishing grounds.

commercial fishermen. In exchange, these fishermen agree to sell their catch to North Coast (see below). In addition, fishermen sometimes make arrangements with recreational vessel owners for winter moorings, although the legality of such arrangements is unclear and the arrangement is only temporary.¹⁸

We spoke with fishermen and others who dispute the limitation on moorings in Stage Harbor or believe that additional moorings could be accommodated. Mark Simonitsch (the pier operator in Stage) asserted that many moorings go unused by recreational vessel owners and that the town has the right to reallocate these moorings if they go unused for two years. One fisherman said that he felt that more moorings could be added to Stage Harbor. Finally, one fisherman suggested that if he needed to moor in Stage, he would simply drop his own mooring and use it.

Harwichport also has a shortage of mooring spaces, and therefore does not represent a viable alternative to Stage Harbor. The Harwich Harbor Master indicated that Saquatucket and Wychmere Harbors can support only about 38 commercial fishing vessels, and the town is not interested in altering the mix of commercial and recreational vessels given the offloading space available (see below). There is a 21-vessel waiting list for these commercial moorings and slips.¹⁹

Steaming Time

Another major deterrent to relocating to Stage Harbor is the added steaming time required to reach the fishing grounds. The 1991 Report assumed an added steam of 3.5 hours (roundtrip) for vessels relocating to Stage Harbor. This is generally consistent with the added steam time noted by fishermen in interviews. A distinction can be made between those fishermen who fish in the ship channel due east of Cape Cod and those who fish in the channel southeast of Chatham (an area sometimes referred to as the Great South Channel), although the added steaming time to these grounds does not appear to differ greatly.²⁰

As we note further below, the added steam has important implications for assessing the economic impacts of the no project condition. In the summer months, when fishing effort is most intense, many day fishermen will fish each day, returning to ALC in the evening and waking up early in the morning to resume fishing. Three or four hours of added steaming time potentially could preclude this type of effort, forcing fishermen to reduce their fishing effort or switch to trip fishing

¹⁸ The Chatham Harbor Master felt that if closely examined, renting of moorings would probably be deemed illegal since "the bottom belongs to the State," and mooring owners would be making money illegitimately on the arrangement.

¹⁹ It is noteworthy that only one of the deep draft vessel operators from ALC is on this list, and this operator has sold his vessel and passed up an opportunity to obtain a mooring. This apparent lack of interest in relocating to Harwichport suggests that these fishermen do not generally consider it a viable alternative.

²⁰ Fishermen indicated little interest in choosing new fishing grounds closer to Stage Harbor. Most importantly, they felt that there are limited productive grounds for the species of groundfish commonly sought.

rather than day fishing. Such reactions would result in a reduction in the catch of premium fish, implying both a loss in Chatham fishermen's revenue and a regional and national economic loss (see below).

In addition to the added length of the steam from Stage, there may be safety implications as well. Several fishermen noted that the waters off Monomoy Island are rough and frequently unnavigable, and that several vessels have capsized in these waters over the years. Most often, fishermen will steam through Pollock Rip Channel, a relatively indirect path for those fishing the south channel area.

Unloading Facilities

Currently in Stage Harbor, there are two areas for commercial fishermen to unload fish. The primary facility is privately-owned and is operated by Mark Simonitsch in cooperation with North Coast Seafood. Opinions differed on the adequacy of this facility. Many fishermen asserted that the facility's operations are outdated and that it would not be able to handle a significant increase in landings. The facility was originally devoted to the trap fishing fleet operating out of Stage, and in the spring the pier is busy handling the catch from this fleet. Some fishermen and the Chatham Wharfinger felt that this would create significant delays for fishermen attempting to reach the pier to offload their fish. In contrast, other fishermen and the pier operator felt that the facilities are adequate for current use and for additional landings.

The other unloading area is a small pier that is also privately-owned. Currently, Chatham Fish and Lobster (a local distributor) is allowed to use the pier. A truck is backed up on the pier and fish are loaded directly from boats to the truck by throwing the fish individually up to the pier and carting them to the truck; fish are then packed at Chatham Fish and Lobster's facility in ALC. Those interviewed felt that this method of unloading is inefficient and could not be expanded to accommodate significantly more fish.²¹

Unloading facilities at Harwichport are also potentially inadequate. Like the second pier in Stage, fish are unloaded directly to trucks in Wychmere (i.e., no mechanical equipment is available). The Harbor Master noted that, because of the proximity of private land and residences, there are no plans to expand these facilities.

Pricing Issues

Another potential disadvantage of Stage Harbor from the perspective of fishermen involves the marketing options for fish brought to Stage. As noted, the majority of fish are unloaded and packed at the privately-owned pier operated by Mark Simonitsch and North Coast Seafood. By selling to North Coast, fishermen may lose access to the lucrative New York fish market. Fishermen, distributors, and brokers interviewed agreed that New York prices are significantly higher than prices in Boston (see earlier discussion). Distributors such as Chatham Fish and

²¹ Stage has two other small privately-owned piers that serve trap fishermen. These facilities could not accommodate landings from additional commercial vessels.

Lobster and Chatham's Finest transport fish to New York and provide fishermen with access to this market. North Coast is a seafood processor rather than a distributor, and therefore does not provide this access. This may result in decreased revenue for fishermen.²²

Other Issues

Several other considerations merit attention in assessing the feasibility of Stage Harbor relative to ALC. These considerations include the following:

- ▶ The Chatham Harbor Master and several fishermen noted that Stage Harbor supports active shellfish beds that yield millions of dollars worth of shellfish each year (primarily clams, quahogs and oysters). These individuals noted that a significant expansion of the commercial fishing fleet in Stage could pose an environmental threat to these beds due to the potential for fuel spills.
- ▶ Commercial fishermen require docking facilities to maintain their vessels and load/unload their gear. Those interviewed felt that docking facilities in ALC were far superior to those in Stage.
- ▶ There is no refueling area in Stage as there is in ALC. In Stage, a truck is backed up on the pier for boats to refuel.
- ▶ The ice-making capability at Stage is limited; only one ice machine is available, and some of those interviewed felt that this would be inadequate if additional fishermen were to use the pier.
- ▶ Stage Harbor has the potential to freeze over in severe winter weather due to the limited tidal flow in the harbor. Several of those interviewed, including the Chatham Harbor Master, noted that this could impede passage of vessels moored there.
- ▶ The Chatham Wharfinger also noted that land use regulations in Chatham would prohibit development of new commercial fishing facilities in Stage Harbor.

²² In addition, as the only major buyer in Stage Harbor, North Coast may exercise a fair degree of pricing power. Several fishermen interviewed noted that they have limited options if they are dissatisfied with the prices they receive from North Coast (the alternative being to steam to another port to sell their fish). This situation may be exacerbated in the case of those fishermen who use moorings owned by North Coast; by arrangement, they must sell to North Coast. Although purely anecdotal, fishermen's comments suggest concern on their part that those working out of Stage may receive a lower price for their fish.

Cost of Operating Out of Stage Harbor

The discussion above outlines several drawbacks to operating out of Stage Harbor for ALC deep draft fishermen and suggests that relocation of more vessels may not be feasible because of a variety of institutional and practical constraints. Foremost among these constraints is the lack of mooring space in Stage Harbor. Despite this constraint, some vessels have already relocated to Stage Harbor through arrangements with the pier operator and owners of private moorings. While no definitive evidence exists, our investigation suggests that additional informal arrangements may enable Stage Harbor to accommodate more commercial fishing vessels. Therefore, we analyze what the economic costs would be if the 11 deep draft fishermen that we estimate would be willing to relocate were able to operate out of Stage Harbor.²³ We emphasize, however, that there is a limit to how many informal mooring arrangements could be established. If the potential for these arrangements is exhausted, the institutional constraint of the Stage Harbor waiting list becomes effective. This would preclude the relocation assumed in the following analysis, and potentially could force the vessel operators in question to leave commercial fishing.

Economic Losses

The economic costs of operating out of Stage Harbor include three elements: (1) added fuel costs due to the added steam to the fishing grounds; (2) added opportunity costs of time due to the added steam for both vessel operators and crew; and (3) the loss of the ex-vessel price premium the fishermen would earn if they operated out of ALC rather than Stage.²⁴

Added fuel costs and added crew costs can be estimated fairly easily. We asked fishermen how their steam time would change if they were operating out of Stage. We use this estimate in combination with estimates of the number of fishing trips each individual takes per year to estimate the total added fuel cost. Based on a diesel fuel price of \$0.92 per gallon and fuel use of nine gallons per hour, we estimate that the average vessel would spend an additional \$2,450 on fuel. For eleven vessels, the total annual cost is therefore about \$26,900.

The opportunity cost of time attributable to the added steam can be calculated in a similar fashion. Crew size varies by vessel and by season; therefore, for each vessel we used an average crew size based on the range provided in the interview. For example, if crews of two and three are used at different times of the year, we use a crew size of 2.5. Combining the crew size information with information on the additional time spent steaming to and from the fishing grounds, we estimate the cost of the additional steaming time. As requested by the Corps, we value each hour of time at one-third of the manufacturing wage rate (\$3.92 per hour from the 1991 Report) in the lower bound, and at the full wage rate (\$11.75 per hour) in the upper bound. Using these figures, we estimate that the cost of the added steam time is between \$34,600 and \$103,700 for the 11 relocated vessels.

²³ Recall that nine of the fishermen interviewed indicated that they already had relocated or would be willing to relocate if possible; to this number, we add two of the four remaining deep draft fishermen who we did not have an opportunity to interview.

²⁴ Note that the costs reviewed here would also be applicable if fishermen relocate to Harwich, since the added steam time and other implications are roughly equivalent.

Estimating the cost associated with the loss of premium fish is much more complex. First, the degree to which the fishermen receive the premium price when operating out of ALC is unclear. As described earlier, many factors affect the likelihood of receiving the premium price (e.g., day fish versus two-day fish, longlined versus gillnetted), and the fishermen that may relocate to Stage have mixed profiles with respect to these factors. Furthermore, the degree to which landings of premium fish would be reduced when operating out of Stage is difficult to specify. For example, some fishermen indicated that the added steaming time may lead them to change their fishing approach, lengthening their trips by a day. Other fishermen indicated that they may fish the same days per trip but may be forced to pull their gear sooner in order to return to port on time. Still others suggested that they may fish fewer days. These responses all have the same outcome in that landings of premium fish would be diminished. However, the degree to which landings of premium fish would decline is highly uncertain.

Our analysis demonstrates the sensitivity of the cost estimate to these considerations. For purposes of developing an upper and lower bound estimate of economic costs due to loss of premium fish, we apply two sets of assumptions:

- ▶ **Upper Bound:** For our upper bound estimate, we assume that all of the fish caught by fishermen working out of ALC receive the freshness premium.²⁵ Furthermore, we assume that as a result of longer trips or reduced fishing effort, one half of these fish would no longer be of premium quality (or would not be caught) when landed by fishermen relocated to Stage Harbor. Finally, we assume the upper bound ex-vessel premium for Chatham fish (\$0.175) is lost on each pound.
- ▶ **Lower Bound:** For the lower bound estimate, we assume that only one half of the fish currently landed at ALC receive the freshness premium. In addition, we assume that only 10 percent of these fish would lose the premium (due to longer trips) or would not be caught (if fishing effort is reduced). Finally, we assume the lower bound ex-vessel premium for Chatham fish (\$0.025).

Using these assumptions in combination with data on fishing effort provided in interviews, we estimate that between about \$2,200 and \$155,100 in value would be lost each year (based on these 11 vessels). This range clearly illustrates the sensitivity of the estimate to the various assumptions. If we assume that the true cost estimate falls between these extremes, costs due to relocation to Stage Harbor can be summarized as shown in Exhibit 5.²⁶

²⁵ As described earlier, we attempted to use catch estimates supplied by the fishermen, but these estimates proved unreliable. We rely instead on the average catch figure from the 1991 Report (1,100 pounds) for all vessels.

²⁶ Appendix B presents the detailed derivation of these figures. As we noted above, these annual costs reflect losses that would be incurred based on the size of the ALC fleet as observed in the 1991 Report. In the long run, regulatory changes and other circumstances could lead fishermen to leave the industry. The annual benefits of navigation improvements in ALC may be less than those

Exhibit 5			
SUMMARY OF COSTS OF RELOCATION TO STAGE HARBOR			
	High Estimate	Low Estimate	Midpoint Estimate
Fuel	\$26,900	\$26,900	\$26,900
Crew	\$103,700	\$34,600	\$69,150
Lost Premium	\$155,100	\$2,200	\$78,650
Total	\$285,700	\$63,700	\$174,700

We should note that in addition to these costs, there are a number of other potential costs that may be incurred by society if a significant number of vessels relocate to Stage Harbor. While developing quantitative estimates of these impacts is beyond the scope of this analysis, we mention them here to demonstrate that the costs of relocation may be greater than the estimates provided above. These other potential economic impacts include the following:

- ▶ An expansion of the Stage commercial fishing fleet could pose an increased environmental threat to shellfish beds in Stage Harbor. Economic value would be lost if these beds are damaged.
- ▶ The limitations of the facilities in Stage Harbor may imply added fishing costs. For example, if vessels must wait to unload at the pier, the value of the delay time is a social cost.
- ▶ Chatham Fish and Lobster may increase the number of fish trucked from the small pier in Stage to the ALC packing facility; although this is a short distance, the cost of transporting the fish would represent an economic loss.
- ▶ The expansion of commercial fishing in Stage may pose a cost to nearby residents due to added noise and activity in the area.

Total Economic Costs

Our analysis of deep draft vessels' response in the no project condition suggests that, in the long-run, fishermen would either leave commercial fishing or relocate to a nearby port (although there are many constraints that will limit the feasibility of relocation). For the 19 vessel operators analyzed, Exhibit 6 summarizes the total economic cost associated with these two responses.

shown here if exogenous factors reduce the size of the commercial fishing fleet over time.

Exhibit 6			
SUMMARY OF ANNUAL ECONOMIC COSTS FOR DEEP DRAFT VESSELS IN THE NO PROJECT CONDITION			
	High Estimate	Low Estimate	Midpoint Estimate
Leave Commercial Fishing	\$133,500	\$66,800	\$100,150
Relocate to Stage Harbor	\$285,700	\$63,700	\$174,700
Total	\$419,200	\$130,500	\$274,850

As shown, we estimate that total economic costs associated with deep draft vessels in the no project condition range from \$130,500 to \$419,200, with a mathematical midpoint estimate of \$274,850.

QUESTION 3: HOW IS THE CATCH OF UNDERUTILIZED SPECIES AFFECTED IN THE NO PROJECT CONDITION?

In contrast to the treatment of fish species that are overexploited, the Corps' SIR Guidance Memorandum notes that, in the no project condition, any reduction in the catch of underexploited species by the ALC fleet would result in a decrease in the national fish harvest. The economic loss attributable to this change would be measured by the associated change in net income (revenues less harvesting costs). In particular, the guidance memorandum notes that a number of ALC fishermen at least occasionally fish for lobster, a species that is not considered overexploited (NMFS currently classifies the offshore lobster fishery as "fully exploited").²⁷ The memorandum calls for additional analysis of the effects of the no project condition on the catch of lobster and other such species.

²⁷ NMFS determines the exploitation status of commercial fish species, classifying species according to the following categories: unknown, not exploited, underexploited, moderately exploited, fully exploited, overexploited, and protected. These terms describe the effect of current fishing effort on each stock, and represent scientists' assessment of each species' status based on current data and knowledge of fish stock dynamics. For the purpose of this analysis, we treat underexploited, moderately exploited, and fully exploited species similarly; i.e., we assume that any reduction in the catch of these species would reduce the national fish harvest. To determine species' exploitation status, we rely primarily upon the exploitation evaluation provided in NOAA Technical Memorandum NMFS-F/NEC-95, Status of Fishery Resources off the Northeastern United States for 1992, October 1992. For species not addressed in that report, we rely on the evaluation provided in NOAA Technical Memorandum NMFS-F/SPO-1, Our Living Oceans: The First Annual Report on the Status of U.S. Living Marine Resources, November 1991.

Methodology

Due to the confidential nature of the information, we were initially unable to obtain NMFS data on under-, moderately, or fully exploited species landed in Chatham. In the absence of this information, we focused our analysis on the potential effects of the no project condition on the ALC lobster catch. We based this decision on the emphasis given to lobstering effects in the Corps' Guidance Memorandum, and on the possibility that changes in the catch of this highly valued species would have greater economic implications than changes in the catch of other species.

To analyze potential effects on lobstering, we first identified lobstermen who moor their vessels in ALC. The Massachusetts Division of Marine Fisheries (MDMF) provided a list of 59 fishermen who in 1992 or 1993 held a commercial lobster license and listed Chatham Harbor (53) or Stage Harbor (6) as their home port. To identify the ALC lobstermen, we compared this information with the Corps' list of 69 vessels licensed to use the ALC municipal fish pier. This comparison enabled us to identify 28 fishermen who both hold commercial lobster licenses and moor their vessels in ALC. All of these fishermen listed Chatham Harbor (not Stage Harbor) as their home port on their lobster license. The Chatham Wharfinger reviewed this list and indicated that it appeared to be accurate.²⁸

Additional data obtained from the MDMF indicate that a small group of the 28 lobster license holders have been responsible for most of the lobster landed by the ALC fleet between 1990 and 1992. Of the 28 individuals identified, only eight hold coastal licenses, which are required in order to lobster within Massachusetts territorial waters. Two of these coastal license holders have not harvested lobsters during the last three years. The remaining six are responsible for roughly 95 percent of the total lobster catch reported by commercial license holders in the ALC fleet. The Chatham Wharfinger agreed that these six lobstermen are the primary lobstermen operating out of Aunt Lydia's Cove.

We interviewed the owner or operator of 22 of the 28 licensed lobster vessels, including five of the six "primary" lobstermen. Of the remaining six vessels, the Chatham Wharfinger indicated that one recently had sunk, and another had been relocated to Rhode Island. We were unable to arrange interviews with the owners or operators of the other four vessels (including the sixth primary lobsterman). The interview questions and protocol were similar to those used in the interviews with fishermen with deep draft vessels. In some cases we had already arranged interviews with specific fishermen to discuss relocation issues; questions concerning their lobstering practices were then added to the interview. In general, the objective of these interviews was to assess the potential impact of the no project condition on the current lobstering practices of each fisherman.

Background Lobstering Information

Massachusetts state law requires anyone taking lobsters from state waters or landing lobsters in the state to obtain a permit from the MDMF (Chapter 130, MA G.L., Section 38). The lobstermen interviewed for this analysis hold one of the following two types of licenses:

- ▶ **Coastal Commercial** - Allows the holder to harvest lobster anywhere, most importantly inside territorial waters (within three miles of the Massachusetts coast).

²⁸ To preserve confidentiality in subsequent use of lobstering data obtained from the MDMF, the identity of commercial lobster license holders will not be disclosed.

- **Offshore Commercial** - Allows the holder to harvest lobster outside territorial waters only.

As discussed previously, only eight of the 28 ALC commercial lobstermen hold coastal licenses. Each of the six primary lobstermen holds a coastal license.

Commercial lobstermen harvest lobsters using a variety of techniques. All of the coastal license holders interviewed use pots (traps) to catch lobsters. In general, these "potmen" begin setting their pots in the water in late spring. The pots are baited and then allowed to "soak" on the ocean bottom for a period of time (for Chatham lobstermen, typically three to five nights). After the soaking period, the lobstermen haul their pots, remove any lobsters, rebait the pots, and set them again. This cycle continues until late fall, when most potmen begin bringing their pots ashore. All pots are typically out of the water by December or January.

The offshore license holders interviewed use non-pot methods of catching lobsters, such as gillnetting and trawling. For these fishermen, lobsters are not a primary target. Although some of these fishermen indicated that lobster revenues may account for a noticeable portion of their total revenues, their typical daily landings are much lower than the coastal potmen's.

Distribution of Catch by Type of License

Data on the quantity of lobsters harvested in recent years by coastal and offshore lobster license holders moored in ALC are presented in the exhibit below.

Exhibit 7					
TOTAL LOBSTER CATCH FOR LOBSTERMEN MOORED IN ALC: 1990-1992					
Year	License Type	Number of Licenses	Number of Lobstermen Who Caught Lobster	Lobstering Method	Lobster Catch (lbs.)
1990	Coastal	8	6	Pots (6)*	146,771
	Offshore	13	4	Trawl (3) Gillnet (1)	7,601
1991	Coastal	8	6	Pots (6)*	193,522
	Offshore	15	6	Trawl (1) Gillnet (5)	9,675
1992	Coastal	8	6	Pots (6)*	199,100
	Offshore	16	6	Trawl (3) Gillnet (3)	14,033
* One coastal lobstermen also reported using diving gear to catch lobsters.					
Source: MDMF Fishery Statistics, April 1993					

As the exhibit shows, coastal license holders are responsible for most of the lobster landed by the licensed lobstermen moored in ALC. In 1990 and 1991, these lobstermen harvested 95 percent of all lobsters reported by commercial license holders in the ALC fleet. Their percentage of the total catch in 1992 was 93 percent, a slight decrease from the previous two years. The data indicate that many of the fishermen holding offshore licenses did not report catching lobster. This observation is consistent with our finding that these fishermen typically do not target lobster.

Distribution of Effort and Catch by Area

For purposes of identifying the location of lobstering activity, the MDMF divides Massachusetts territorial waters into 14 statistical reporting areas, numbered 1 through 14. Similarly, MDMF divides offshore waters into 11 statistical reporting areas, numbered 15 through 25; the boundaries of the offshore areas correspond to those of NMFS statistical areas, except where the Massachusetts territorial line runs through them. Figures 1A and 1B illustrate the boundaries of these areas.²⁹

MDMF data allow us to characterize the location of fishing effort for the six active coastal license holders. Exhibit 8 summarizes the data. As the exhibit shows, these lobstermen split their effort fairly equally between territorial and non-territorial waters.

Exhibit 8				
DISTRIBUTION OF EFFORT FOR COASTAL LOBSTER LICENSE HOLDERS MOORED IN ALC: 1990-1992				
Year	Location	Percent of Trips	Percent of Pots Fished	Percent of Trap-Hauls
1990	Territorial	50%	57%	51%
	Non-Territorial	50%	43%	49%
1991	Territorial	46%	55%	47%
	Non-Territorial	54%	45%	53%
1992	Territorial	54%	60%	55%
	Non-Territorial	46%	40%	45%
Source: MDMF Fishery Statistics, April 1993				

²⁹ These figures are taken directly from David C. McCarron and Thomas B. Hoopes, 1991 Massachusetts Lobster Fishery Statistics, Massachusetts Division of Marine Fisheries Publication Number 17221-24-200-10/92-.58-C.R.

Figure 1A. 1991 Massachusetts Lobster Fishery: Statistical Reporting Map Showing Territorial Waters and Outlying Areas

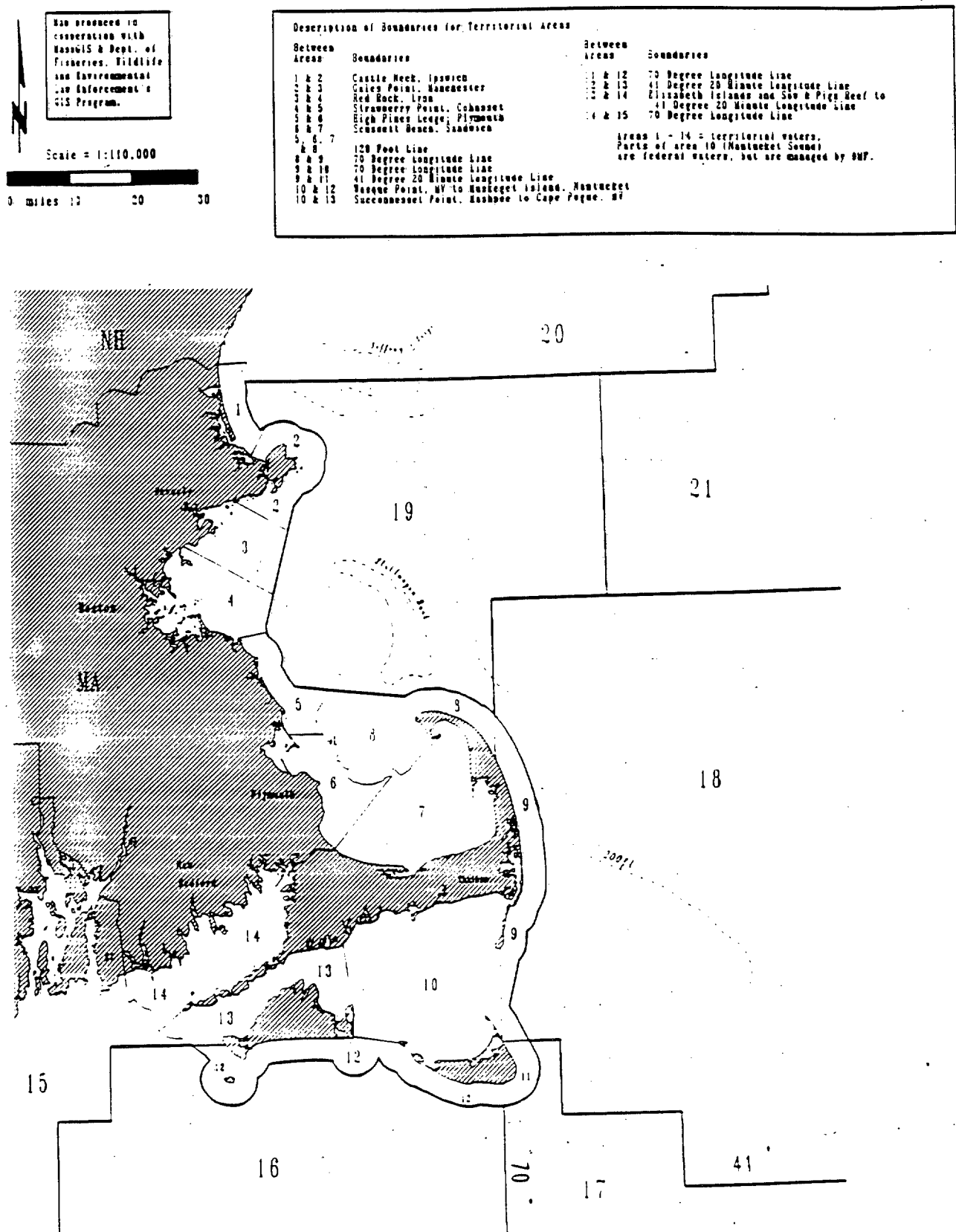
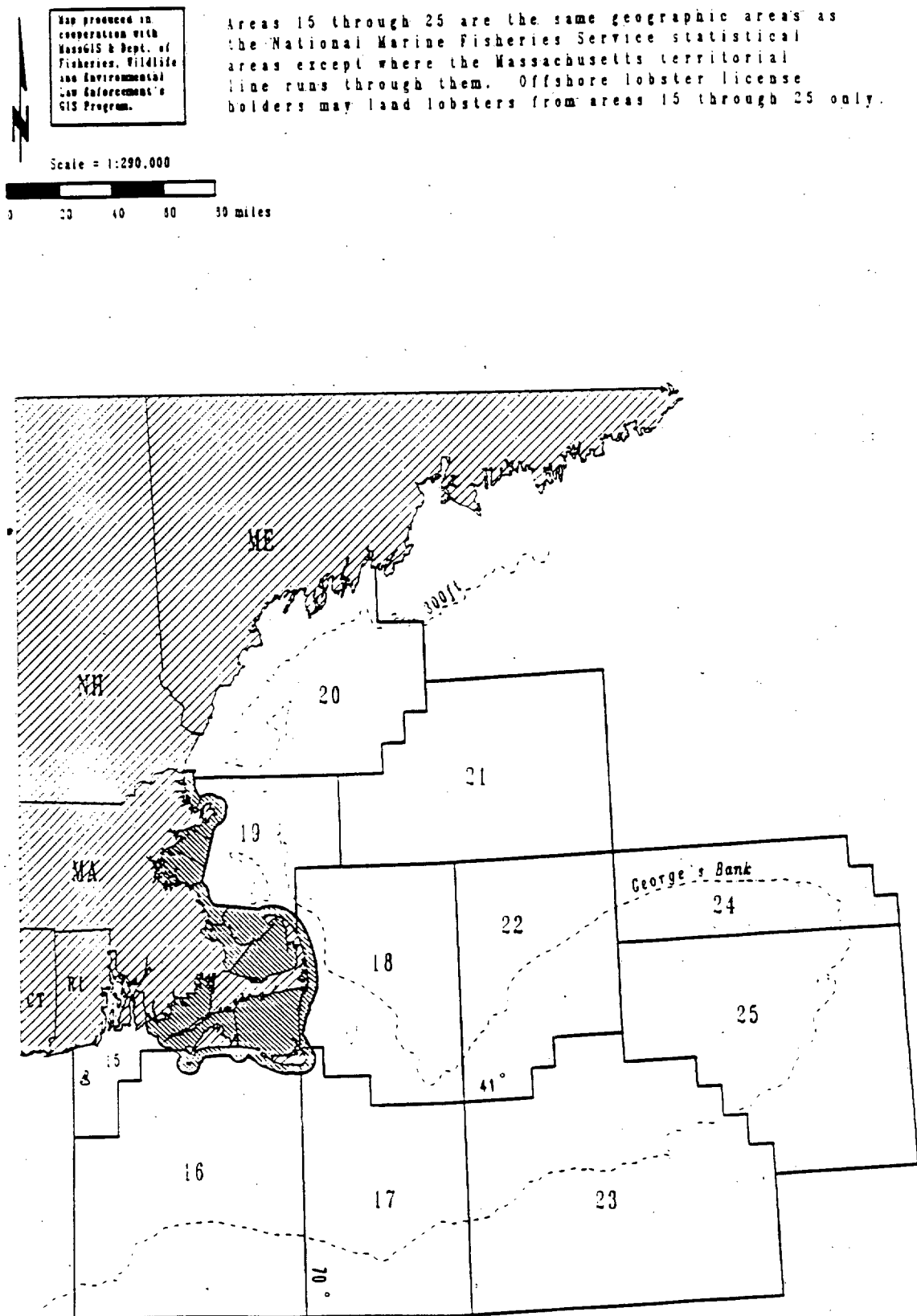


Figure 1B. 1991 Massachusetts Lobster Fishery; Statistical Reporting Map Showing Offshore Areas (which correspond to the National Marine Fisheries Service statistical areas)



In addition to data on the distribution of fishing effort, we obtained data for 1992 on the distribution of catch by area. These data indicate that 57 percent of the total catch landed by the six coastal license holders was harvested in Area 9, within the territorial waters of Massachusetts. The remaining 43 percent of the catch was taken in non-territorial waters, primarily Area 18. This distribution of catch is quite close to the distribution of trap hauls for 1992.

Status of Lobster Stock

As noted above, NMFS currently characterizes the offshore lobster fishery as fully exploited. This designation does not necessarily apply to inshore lobster fisheries, where fishing effort is generally more intense. According to Bruce Estrella, a fisheries biologist with MDMF, exploitation rates for lobster in Massachusetts waters typically exceed those for lobster in non-territorial waters; the catch in these areas is dominated by small, immature lobster, generally within one or two molts of the minimum legal size. The lobster fishery in the territorial waters used by ALC lobstermen, however, is not based upon an endemic, local resource, in part because the sandy bottom in the area offers relatively poor lobster habitat. Instead, the fishery in Area 9, like that in Area 18, is based upon an offshore, migratory stock of lobster. As a result, far fewer "short" lobster are taken in these waters, an observation consistent with the anecdotal information provided by lobstermen we interviewed. In light of this assessment, our analysis of the impacts of the no project condition on the lobster catch draws no distinction between lobster taken in territorial and non-territorial waters; we treat the resource as an offshore stock, and rely on the NMFS characterization of that stock as fully exploited to estimate potential impacts on the regional lobster catch.

Impact of the No Project Condition on the Lobster Catch

To evaluate the impact of the no project condition on the total quantity of lobsters harvested by the ALC fleet, we focused our analysis on the potential changes in lobstering practices of the five active coastal license holders we interviewed. Because the data provided by MDMF and the information obtained from our interviews indicate that fishermen with offshore licenses account for only a minor portion of the fleet's total lobster catch, we have not included them in this analysis.

When asked about their likely response if no navigation improvements were undertaken in Aunt Lydia's Cove, two of the five interviewed said that they would most likely go out of business, two that they would relocate their vessels to nearby harbors, and the fifth that he would continue working out of ALC using skiffs. The rationale for these changes, and their resulting impacts on lobstering costs and revenues, are discussed in more detail below.

Go Out of Business

Two coastal lobstermen indicated that in the absence of a project, they probably would go out of business. Both of these lobstermen felt that shoaling would soon make the spar channel impassable during most (and possibly all) tidal stages. To continue working out of ALC, they would have to moor their vessels in the outer cove and skiff their catch and equipment into the fish pier. Both lobstermen indicated that this arrangement in the long-run would not be viable. They would need to skiff bait and gasoline to their vessels each morning and skiff their catch into the fish pier

each night, a process that would add a few hours to their workday and increase the risk of accidents. In addition, at the beginning and end of the lobster season, the lobstermen need to load/unload their pots directly from their vessels to the fish pier. Skiffing their traps between their vessels and the fish pier would be extremely time and labor intensive. Finally, it is important to note that outer cove moorings may not be available.

Both lobstermen also indicated that they do not consider relocation feasible. Mooring space at nearby harbors is limited, and the waiting lists for moorings are long. In addition, the lobstermen's vessels are relatively slow (8-9 knots), and they would experience substantial increases in steaming time to their fishing grounds from alternative ports (approximately four hours round trip from Stage Harbor, for example). Neither lobsterman was willing to abandon his habitual harvesting grounds in favor of alternative grounds. Finally, the lobstermen felt that none of the nearby harbors have the support facilities necessary for their operations, including a dock that can be reached in their vessels, gasoline and bait facilities, and parking space.

These lobstermen also stated that they would not purchase shallower draft or faster vessels. Although both have invested substantial financial resources in their current vessels, they believe they would have difficulty selling them at a reasonable price because of their slow speed. In addition, these lobstermen feel that shallower draft vessels would introduce an unacceptable safety risk. Given the lack of viable alternatives, they believe they would be forced out of business.

Relocate to Another Harbor

Two of the coastal lobstermen interviewed felt that in the absence of a project, they would eventually relocate to nearby harbors. These lobstermen are able to relocate for two main reasons; they both expect to be able to obtain year-round mooring space, and they both operate relatively fast vessels (12-16 knots), reducing the adverse effect of relocation on steaming time to their fishing grounds. Both of these lobstermen indicated that relocation would force them to reduce their lobstering effort.

The first lobsterman indicated that he could obtain access to a year-round mooring in Stage Harbor through an acquaintance. However, he felt that increases in steaming time to his fishing grounds and the uncertain availability of support facilities would lead him to scale back his operation substantially. His personal financial situation would allow him to take this course of action. He estimated that he would fish only 25 percent of his current pots, and would set them in the southernmost of his traditional fishing grounds, which would add approximately two hours to his round trip steaming time. He would no longer hire a crew person, and would therefore haul all his lobster pots himself.

The second lobsterman indicated that he may eventually relocate to Saquatucket if conditions in the spar channel worsened substantially. He stated that he is first on the waiting list for a mooring space in that harbor. He estimated that relocation would increase steaming time to his fishing grounds by approximately two hours round-trip. To offset this increase in steaming time, the lobsterman indicated that he would reduce his hauling time by two hours per day.

Continue Working Out of ALC

The fifth lobsterman interviewed also owns a fish market located next to the fish pier. Because of this relationship, he indicated that he would continue working out of ALC, even though he may eventually have to skiff his catch into the fish pier. He sells all of his lobsters through his market, and would incur substantial additional costs if he had to unload his catch at another harbor and truck it back to ALC.

The time required for skiffing would reduce the total number of hours available for hauling his pots. Although he did not estimate this reduction, it may be substantial. It would probably be necessary to skiff bait and gas to his vessel in the morning, and his catch would have to be skiffed into the fish pier at the end of the day. Skiffing his pots out at the beginning of the season would be difficult, and might force him to set some of his pots later in the year. Finally, skiffing his pots in at the end of the season might force him to pull some of his pots from the water sooner than in previous years.

Impact of Operational Changes on Lobstering Effort and Catch

The changes in operation identified above will lead to a reduction in lobstering effort by each of the five coastal lobstermen. We have estimated changes in effort for each lobsterman as a percentage reduction in annual pot hauls. These estimates are presented below.

- ▶ The two lobstermen forced out of business would reduce annual pot hauls by 100 percent.
- ▶ The lobsterman relocating to Stage Harbor would reduce his total pot hauls per year by 75 percent. This estimate reflects his assertion that he would fish 75 percent fewer pots, and that he would haul proportionally fewer pots per day. Because he would no longer hire a crew person to help haul his pots in this scenario, and because additional steaming time would reduce the time available to haul pots, this assessment seems reasonable.
- ▶ The lobsterman relocating to Saquatucket would reduce his total pot hauls per year by 20 percent. To offset the increased steaming time to his fishing grounds (approximately 2 hours per trip), he indicated that he would reduce his hauling time by 2 hours per day. Under the assumption that the typical lobsterman works 10 hours day, this reduction in hauling time implies a 20 percent reduction in the number of pots he would haul per day.
- ▶ The lobsterman continuing to work out of ALC would reduce his total pot hauls per year by 35 percent. We have assumed that skiffing bait and gas to his vessel in the morning and skiffing his catch into the fish pier would reduce available hauling time by 2 hours per day. Assuming a 10 hour workday, this reduction in hauling time implies a 20 percent reduction in the number of pots he would haul per day. In addition, at the beginning and end of the season, the lobsterman would have to skiff his pots between his vessel and the fish pier. In the interview, he indicated that he can typically load

about 50 pots into his vessel. Based on MDMF data, the typical coastal lobsterman based at ALC fishes 780 pots. This information suggests that it takes approximately 16 trips (780/50) to get all pots into the water at the beginning of the season, and an equivalent number of trips to bring them ashore at the end of the season. We have assumed that skiffing 50 pots to/from his vessel would take an average of 4 hours per trip. This would lead to increased skiffing time of 128 hours per season ($4 * 32$). Assuming no increase in yearly work effort, this delay would reduce available hauling time by an equivalent amount, implying a decrease in effort of approximately 15 percent ($128/920$), and a total decrease in effort of 35 percent.³⁰

These estimates suggest that the five coastal lobstermen interviewed may reduce their total pot hauls per year by an average of 66 percent in the no project condition.³¹ Under the assumption that the sixth coastal lobsterman will experience a similar reduction in effort, total effort by coastal lobstermen currently moored in ALC may be reduced by 66 percent.

This reduction in total pots hauled per year will lead to a decrease in lobster landings by the six coastal lobstermen. We have assumed that the decrease in catch will be proportional to the decrease in effort. This assumption is based on our belief that the lobstermen would continue to use the same set-over day period for their pots. In the interviews, the lobstermen indicated that they currently use a set-over day period that is appropriate for the lobstering conditions (i.e., water temperature, water depth, type of bait, speed of lobster migration, etc.) near Chatham. Because the lobstering conditions would not be affected by the no project condition, it is unlikely that the lobstermen would substantially change their set-over day period.

In 1992, the total quantity of lobster landed by the six lobsterman moored in ALC with coastal commercial licenses was 199,100 pounds. Assuming that average landings per pot haul remain constant, a 66 percent reduction in effort by these lobstermen in the no project condition would lead to a reduction in catch of approximately 131,400 pounds per year. Data from NMFS indicates that the 1991 weighted average ex-vessel price for lobster in Barnstable County was \$3.29 per pound. Using this price, the value of the 131,400 pounds of lobster lost annually to the six coastal lobstermen in the ALC fleet would be approximately \$432,300.

³⁰ It is possible that to avoid a loss in hauling time, the lobsterman would increase his yearly work effort by setting his traps earlier in the season and/or pulling them later. This course of action would lead to increased operating costs, primarily for labor and fuel. In the absence of definitive information concerning his response to this situation, we have assumed that he would not increase his yearly work effort.

³¹ The average percentage reduction in effort by these five lobstermen is $((100 + 100 + 75 + 20 + 35) / 5)$, or 66 percent.

Impact of Operational Changes on Lobstering Costs

The change in lobstering effort described above would lead to changes in operating costs for each of the five coastal lobstermen interviewed. Consistent with the 1991 Report, we estimated changes in fuel and labor costs resulting from changes in operation in the no project condition. In addition, we estimated potential impacts on bait expense and pot replacement costs. The results of this analysis are shown in Exhibit 9.

For this analysis, we first estimated the change in fuel use per trip associated with lobsterman's change in operation in the no project condition. These estimates are presented below.

- ▶ The two lobstermen forced out of business would reduce their daily fuel use by 100 percent.
- ▶ The two relocating lobstermen would increase steaming time by two hours per day, increasing their total usage of fuel. However, both indicated they would offset their increase in steaming time by reducing the time spent hauling pots by two hours per day. This reduction in pot hauling time would lead to small savings in fuel use.
- ▶ The lobsterman continuing to work out of ALC would experience no change in fuel use. We assumed that the fuel saved by reducing hauling time will be roughly equivalent to the fuel used while skiffing.

To calculate total annual changes in fuel costs, we made the following assumptions;

- ▶ The rate of fuel use during steaming is 9 gallons per hour. This assumption was used in the 1991 Report, and is within the range cited by the lobstermen in the interviews.
- ▶ The rate of fuel use during hauling is 2 gallons per hour. This estimate is based on information provided by one of the lobstermen.
- ▶ Current average fuel use per trip is 29 gallons. This estimate assumes 1 1/3 hours steaming and 8 2/3 hours hauling per trip, and is based on information obtained in the interviews. This estimate falls within the range of 25 to 35 gallons per trip estimated by one lobsterman.
- ▶ On average, the coastal lobstermen take 92 trips per year. This assumption is based on trip data provided by MDMF.
- ▶ The cost of diesel fuel is \$0.92 per gallon, as assumed in the 1991 Report. All five lobstermen use diesel fuel in their vessels.

As indicated in the exhibit, the operational changes described above would reduce total annual fuel expenses for the five coastal lobstermen interviewed by approximately \$2,600. Under the assumption that the sixth lobsterman experiences a proportional decline in fuel use and costs, the six coastal lobstermen may reduce total annual fuel expenses by \$3,100.

Exhibit 9

Fuel Costs

Total (interviewed lobstermen):	-2588
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Labor Costs

Total (interviewed lobstermen):	-21638	-64860
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Bait Costs

Total (scaled up to include sixth coastal lobsterman): -15960

Pot Replacement Costs

Total (scaled up to include sixth coastal lobsterman): -7429

Changes in lobstering effort will also affect the opportunity cost of time devoted to lobstering. The expected impact of the lobstermen's operational changes on labor time is outlined below.

- ▶ The two lobstermen forced out of business will reduce their labor by 100 percent. These lobstermen currently employ a total of 3 additional full time workers to help with their operations.
- ▶ The lobsterman relocating to Stage Harbor indicated that he will no longer hire a crew person to help haul his traps. This lobsterman indicated that his personal labor effort would remain approximately the same.
- ▶ The lobsterman relocating to Saquatucket indicated that his total labor effort would not change.
- ▶ The lobsterman continuing to work out of ALC indicated that his total labor effort would not change.

To calculate the impact of these changes on the opportunity cost of time devoted to lobstering, we assume that lobstermen work 10 hours per trip, an estimate obtained from the interviews. As in the relocation analysis, we employ two alternative values for the opportunity cost of time: \$3.92 per hour, one-third the full manufacturing wage cited in the 1991 Report; and \$11.75 per hour, the full manufacturing wage. As indicated in Exhibit 9, the estimated annual decrease in opportunity costs for the five lobstermen is \$21,600 at the lower rate and \$64,900 at the higher rate. Assuming that the sixth lobsterman experiences a proportional reduction in labor time and employing one-third the full manufacturing wage, the annual decrease in opportunity costs would be approximately \$26,000; at the full manufacturing wage, the reduction in opportunity costs would be \$77,800 per year.

Reduction in lobstering effort in the no project condition would also reduce the bait expense for these lobstermen. We have assumed that their decrease in bait use would be directly proportional to their reduction in lobstering effort. Based on our average effort reduction estimate of 66 percent per lobsterman, we estimate that their annual bait expense would decrease by 66 percent. To calculate the current annual bait expense, we have assumed a bait price of \$0.22 per pot/haul. This information was provided by one of the lobsterman.³² MDMF data indicate that in 1992, the six coastal lobstermen made 109,919 pot hauls. At \$0.22 per pot haul, the bait needed to stock these pots would cost \$24,200. Assuming a 66 percent reduction in this expense in the no project condition, the value of bait savings would be approximately \$16,000.

³² According to this individual, 100 pounds of bait costs \$6.50. He estimated that 100 pounds is enough bait for 30 pots, and stated that in the Chatham area, lobstermen generally change their bait every time they haul a pot. Based on this information, we estimate that bait costs approximately \$0.22 (\$6.50/30) per pot haul.

Finally, the lobstermen's reduction in effort will lead to reductions in the costs associated with pot replacement (lobstermen annually lose some pots to trawlers, storms, breakage, and other sources). Assuming a constant rate of pots hauled per hour and a constant set-over day period, reduction in hauling time will force the lobstermen to fish fewer pots. Based on these assumptions, the decrease in the total number of pots fished would be directly proportional to the decrease in effort.

MDMF data indicate that in 1992, the six lobstermen fished 4,690 pots. Assuming a 66 percent reduction in this total, these lobstermen would fish 3,095 fewer pots in the no project condition. In the interviews, the lobstermen indicated that they must annually replace about 5 percent of their pots. Based on this information, the six lobstermen currently replace roughly 235 pots per year. In the absence of a navigation improvement project, these lobstermen would replace only 80 pots annually, a reduction of 155 pots. MDMF data indicate a per-pot value of \$48 in 1992. The reduction in pot replacement would therefore lead to a cost savings of approximately \$7,400.

Net Impacts

The net impact of the lobstermen's projected operational changes on their annual revenue and operating costs is shown below.

Decrease in Annual Revenue:	\$432,300
Decrease in Annual Operating Costs:	
Fuel Costs:	\$3,100
Time Costs:	
One-Third Manufacturing Wage	\$26,000
Full Manufacturing Wage	\$77,800
Bait Costs:	\$16,000
Pot Replacement Costs:	\$7,400
Decrease in Annual Net Income:	
One-Third Manufacturing Wage	\$379,800
Full Manufacturing Wage	\$328,000

As indicated, our analysis suggests that under the no project condition, net income from lobstering would decline approximately \$328 thousand to \$380 thousand per year.

Limitations and Uncertainties

Our estimates of reductions in lobstering effort, catch, and costs in the no project condition are subject to a number of limitations and uncertainties. In general, available information suggests that further investigation of these issues is unlikely to result in substantial changes to our conclusions. Additional data collection would be necessary to more accurately assess their potential impact.

Offsetting Increases in Catch and/or Effort

Our analysis of the impact of the no project condition on lobstering revenues assumes that a reduction in catch on the part of lobstermen out of ALC results in a commensurate reduction in the regional catch. Whether this assumption is valid depends upon whether -- all other things equal -- a decrease in effort by ALC lobstermen would affect the catch of other lobstermen. The validity of the assumption also depends upon how other lobstermen respond to opportunities that may arise as a result of diminished effort on the part of the ALC fleet.

It is possible that a reduction in effort on the part of ALC lobstermen could have a beneficial effect on the catch per unit of effort experienced by other lobstermen, at least partially offsetting the decrease in regional catch estimated above. As noted previously, the lobster fishery east of Cape Cod depends upon an offshore, migratory stock. Because this stock is mobile, it is at least feasible that lobster not caught by fishermen out of ALC may subsequently be caught by lobstermen fishing other areas, with little or no increase in effort.³³ The probability and magnitude of any such increase in catch per unit of effort, however, is unclear. In the absence of data characterizing this relationship, we have relied upon the overall assessment of the lobster stock as fully exploited. Consistent with this assessment and the Corps' guidance, we have assumed that a reduction in catch by lobstermen out of ALC results in an equivalent reduction in the regional lobster catch.

It is also possible that the potential reduction in catch projected for ALC lobstermen might be at least partially offset by increased effort from lobstermen moored in nearby harbors. Theoretically, these lobstermen might take advantage of the reduced presence of ALC lobstermen to expand their operations.

To properly address this issue, it would be necessary to conduct interviews with lobstermen moored in nearby harbors. Although we did not collect these data, available information suggests that a substantial increase in effort by these lobstermen is unlikely. MDMF data indicate that only six fishermen moored in Stage Harbor held a commercial lobster license in 1992 or 1993. Discussions with two of these lobstermen suggest that their ability to expand their effort is constrained by several factors, including vessel, docking, and storage facility limitations.

³³ It is also possible that lobstermen who continue to operate out of ALC (or others who continue to lobster in waters currently fished by ALC lobstermen) would experience an increased catch per unit of effort as a result of the overall decrease in effort throughout the area. The effect of any such increase on our analysis of lobstering impacts would be the same as that described above.

Increased steaming requirements may also discourage other lobstermen from relocating their effort to exploit the Chatham lobstering grounds. In addition to the potential increases in fuel and labor costs, state law in Massachusetts only permits the hauling of traps in state waters from a half hour before sunrise to a half hour after sunset. To ensure sufficient hauling time, lobstermen from other regional harbors might be forced to operate their vessels at night, a sacrifice they may be unable or unwilling to make. Moreover, lobstermen from other ports would be unable to expand to the Chatham grounds without incurring higher operating costs. Thus, any change in effort that might offset the catch lost by ALC lobstermen would likely be achieved only at costs exceeding those currently incurred by the ALC lobster fleet.

With respect to the possibility of increased effort from other ports, it is also important to note that no new coastal lobster licenses have been issued in Massachusetts since 1988. The state moratorium on new licenses makes it highly unlikely that new entrants could obtain a coastal license and begin harvesting lobster in the territorial waters off Chatham.

No Project Conditions in the Spar Channel

In its 1991 Report the Corps assumed that, in the absence of a project, depth in the spar channel would be 1 foot at mean low water, with a tidal range of up to 4.6 feet. In our interviews, the lobstermen described potential changes in their operations based on their expectations about spar channel depth in the no project condition. Although they did not explicitly identify these expectations, many felt that uncontrolled shoaling would make the spar channel impossible to navigate at most (if not all) tidal stages. Depending on their vessel drafts, this assumption may or may not be consistent with the Corps' expectations.

Information obtained during the interviews indicates that the unloaded drafts of the coastal lobstermen's vessels range from 3'6" to 3'10"; loaded drafts are between 4' and 4'2". Based on the tidal information used in the 1991 Report, vessels with 4' drafts will be able to pass through the spar channel during only 3.9 hours of each 12.4 hour tidal cycle. It is therefore likely that the operations of these lobstermen would be severely disrupted by shoaling. Although passage through the spar channel might still be possible, constraints particular to lobstering would make it difficult to play the tides. As discussed previously, lobstermen are prohibited from hauling traps in state waters during the night. In addition, a few of the lobstermen noted that they do not have the facilities necessary to keep their lobster catch alive overnight, and so must return to the fish pier by 6:00 pm to sell their catch.

Ryder's Cove

Although none of the lobstermen we interviewed indicated that such options were available, it is at least theoretically possible that lobstermen could avoid depth problems in the ALC spar channel by offloading their catch at the bulkhead in Ryder's Cove (or elsewhere in Pleasant Bay), where lobster buyers could potentially meet them.

According to the Chatham Wharfinger this scenario is not feasible, primarily because of extensive shoaling in the channel that leads to Ryder's Cove. The Wharfinger identified four specific areas that he believed would be too shallow for the lobster vessels to navigate during substantial portions of the tidal cycle.

- ▶ Allen Point
- ▶ South of Fox Hill
- ▶ Bassing Harbor, at the inlet to Ryder's Cove
- ▶ An area approximately halfway into Ryder's Cove

In addition to the shoaling problems, the Wharfinger noted that the Ryder's Cove landing is not conducive to commercial fishing operations. There are no commercial facilities (i.e., storage, ice, fuel, etc.), and current zoning laws would likely prohibit commercial construction. The boat ramp at Ryder's Cove is frequently used by owners of recreational vessels in the summer, increasing congestion, and the small parking lot is very crowded during the tourist season.

Other Species

After we completed our interviews of ALC fishermen, we were able to obtain 1991 data from NMFS on the catch and value of species landed in Chatham. In order to preserve the confidentiality of the buyers who provide this information, we are prohibited by NMFS from disclosing it. Abstracting from these data, however, provides some useful information on recent landings of species in Chatham, and thus may provide some insight to the potential effect of the no project condition on the catch of species (other than lobster) that are not considered overexploited.

The NMFS data identify, by species and market category, the catch (in pounds) and value (in dollars) of fish landed in Chatham in 1991. Based on current NMFS assessments, we have identified eight species landed in Chatham that are considered underexploited and six that are considered fully exploited. Many of these species are of relatively low value, and are landed in small quantity; in total, they account for approximately \$600 thousand dollars in ex-vessel revenues, or well below 10 percent of the total value of Chatham landings reported by NMFS. Not all of these fish are landed at Aunt Lydia's Cove, since the NMFS data include landings from elsewhere in Chatham. Indeed, the value of such fish landed at ALC may be well under \$600 thousand per year, since it is our understanding that at least one of the larger categories of underexploited species landed in Chatham is commonly caught by trap fishermen operating out of Stage Harbor. We have a very limited basis, however, for allocating portions of this catch to ALC and other locations. Based solely on a comparison of the species listed and our understanding of the species landed by fishermen from ALC and elsewhere, we estimate that the annual value of underexploited and fully exploited species currently landed at ALC (excluding lobster) may range from \$300 thousand to \$500 thousand, with a midpoint estimate of \$400 thousand.

Although underexploited or fully exploited species make up a relatively small proportion of the total Chatham catch, the impact of the no project condition on the catch of such species may be important. Unfortunately, our interviews provide little basis for estimating this potential effect,

since they focused almost exclusively on fishermen who target other species. The interviews do, however, suggest that draggers, rather than gillnetters or longliners, are likely to account for most of the landings of underexploited or fully exploited species at ALC. Thus, any change in the catch of such species in the no project condition would largely depend upon the effects of this situation on vessels rigged as draggers. For example, a change in operation that resulted in a 20 percent reduction in effort (e.g., fishing days) for these vessels might translate to a proportional reduction in the catch of underexploited or fully exploited species. If the Corps agrees with this assumption and the estimate of catch value provided above, it may be possible to estimate the potential effect of the no project condition on the catch of underexploited or fully exploited species other than lobster, and to integrate this estimate with the remainder of the Corps' analysis.

Appendix A
FISHERMAN QUESTIONNAIRE

INFORMAL INTERVIEW GUIDE FOR CHATHAM HARBOR FISHERMEN

Vessel and Gear Information

[Note: where possible, verify information as reported in 1991 Corps Report and docking permit applications]

- Type and length of vessel:
- Principal types of gear:
- Unloaded vessel draft:
- Loaded vessel draft:
- Engine/fuel type:
- Fuel use (underway and idle):
- Vessel speed (loaded and unloaded) and range:
- Crew size:
- Lobstering permit, if applicable (coastal or offshore):

Homeport/Mooring

- Where do you currently moor your vessel?
- How long have you moored there?

Fishing Practices (Using the supplementary data sheet)

- **Finfish/Non-trap Lobstermen**
 - What species do you target? Does this vary seasonally? If so, how?
 - Do non-target species (i.e., by-catch) make up a significant portion of your total catch? If so, what species? (For offshore lobstermen: Do you specifically target lobster when you fish, or is lobster primarily "by-catch"?)
 - In what area(s) do you fish? Does the location vary seasonally? If so, how?
 - How long does it take you to steam to your fishing grounds, to fish the grounds, and to return to port? What factors affect total trip time?

- Roughly how many trips do you make in each of the 12 months of the year? [Note: Are fishing trips equivalent to fishing days?]
- What is your typical catch (per trip, per month, or per year, by species)? [Note: Use supplementary data sheet.]
- **Lobstermen/Traps**
 - In what area(s) do you set your traps? Does the location vary seasonally? If so, how?
 - How many traps do you set/haul on each trip? Does this vary seasonally? If so, how?
 - How long does it take you to steam to your lobster grounds, to haul your traps, and to return to port? What factors might affect total trip time?
 - Roughly how many trips do you make in each of the 12 months of the year? [Note: Are fishing trips equivalent to fishing days?]
 - What is your typical set-over time? Do you vary set-over time seasonally? If so, how?
 - What is your typical catch (per trip, per month, or per year)? [Note: Use supplementary data sheet.]

If moor at ALC:

- Do you moor in the inner cove or outer mooring areas?
 - If outer area, how long have you moored there?
 - ▶ If relocated there since 1987, why did you relocate?
 - ▶ Do you offload in the inner cove? If so, how do you transport your catch to the pier?
- To whom do you sell your catch (to buyers at the pier or elsewhere)?
- If no navigation improvement project were undertaken, would your passage in and out of ALC be affected? How so?
 - Probe: Unable to navigate the inner channel? What is the high-tide clearance in the spar channel? [Note: Corps assumes -4.5 feet]

- In the long run, would you change your fishing operation if no project is pursued in ALC? If so, how?
 - Could you continue operating out of ALC?
 - ▶ Probe: If you currently moor in the outer harbor and offload to skiffs, could you continue to do so indefinitely?
 - If yes, does this offloading activity affect the number of trips you make in a given year, and/or your total annual catch? How so?
 - Does offloading to skiffs affect the price you receive for your catch? [Note: Is there a "freshness premium" for fish landed at ALC that is not paid elsewhere?]
 - ▶ Probe: Could you sell your boat, buy a shallow draft vessel and continue operating out of ALC?
 - Approximately what would your current vessel sell for? Does this include navigation equipment and fishing gear?
 - Approximately how much would a comparable shallow draft vessel cost? Does this include navigation equipment and fishing gear? How would you finance such a purchase?
 - Would changing vessels affect your fishing operation? If so, how?
 - Probe: Would a shallow draft vessel change the holding capacity for your catch? If yes, how so?
 - Probe: Would the speed of your new vessel differ from the speed of your old vessel? If so, how? Would this affect your steaming time? If so, how?
 - Probe: Would a shallow draft vessel change the number of trips you take each year? If yes, would this affect your annual catch? If so, how?
 - Is permanent relocation to Stage Harbor (or another harbor) feasible? Why or why not?
 - ▶ Would steaming time to your current fishing grounds change? If so, how?
 - ▶ Are there alternative lobster/fishing grounds? If so, would you relocate your effort to these grounds? Why or why not?
 - ▶ Would you change your fishing approach? How so?
 - ▶ Would you change the number of trips taken each year if operating out of a new harbor? If so, how? What effect, if any, would such a change have on your total annual catch?
 - ▶ Would a change in port affect the price you receive for your catch? If so, how?
 - ▶ Would a change in port affect the ease of marketing your catch? If so, what effect, if any, would this have on your operating costs?

- Would you leave commercial fishing? If so:
 - ▶ Why?
 - ▶ What price would you receive for your vessel and gear?
 - ▶ What alternative occupation would you pursue?

If moor in area other than ALC:

- Why did you relocate from ALC?
- What were your relocation costs? [Note: mooring fees?]
- Do you still fish/lobster in the same grounds as when you operated out of ALC?
 - If yes, where do you fish/lobster (use map)?
 - If no:
 - ▶ When operating out of ALC, where did you fish/lobster (use map)?
 - ▶ Where do you currently fish/lobster (use map)?
 - ▶ Why did you change your location?
 - ▶ How does the catch at this new location compare with the catch at your previous location?
- Have other aspects of your fishing operation changed as a result of relocating? If yes, how and why? [Note: Use supplementary data sheet, comparing fishing from ALC to fishing from new port.]
- Has locating to this new port changed the costs and revenues of your fishing operation?
 - Have you switched to a new vessel or modified your vessel in any way? If so, please explain, and estimate the cost of any changes.
 - Was there a change in your steaming time? If so, what was the change? [Note: If steaming time changes, is it attributable to vessel speed, distance, sea conditions, etc.?)
 - Have you changed the number of trips you make each year? If so, how? [Note: Use supplementary data sheet, comparing effort from ALC to effort from new port.]
 - Has any change in fishing effort (trips, etc.) affected your annual catch? If so, how?

- Do you still receive the same price for your catch as you would if you operated out of ALC? If not, why? How do the prices differ? [Note: Is there a "freshness premium" for fish landed at ALC that is not paid elsewhere?]
- Do you sell your catch to commercial fish/lobster buyers who operate at this harbor? If not:
 - How do you get your catch to market? Does this affect to your operating costs? If so, how?
- Is this a permanent relocation?
 - If no:
 - ▶ Why not?
 - ▶ In the long run, would you change your fishing operation if no navigation improvement study were pursued in ALC?
 - Would you return to ALC if the channel were regularly maintained?

Number Days Fishing for Each Species

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Typical Daily Catch of Each Species

Species	Daily Catch (lbs.)

Appendix B

**CALCULATIONS OF ECONOMIC COSTS
AND REVENUE LOSSES FOR VESSELS
RELOCATING TO STAGE HARBOR**

**ESTIMATED COSTS OF OPERATING OUT OF STAGE HARBOR:
HIGH ESTIMATE**

Chatham Premium:

- Market Price =	\$0.35
- Ex-Vessel Price =	\$0.175
Wage Rate =	\$11.75
Fuel Price =	\$0.92
Fuel Use (gal/hr.) =	9

ECONOMIC COSTS

	Crew Size *	Added Steam (hours)	Fishing Trips**	Catch Per Day (lbs.)	Fishing Days***	Percent of Catch On Which Premium is Lost	ADDED FUEL COST	ADDED CREW COST	LOST CHATHAM PREMIUM	TOTAL
1	2.5	5	100	1100	200	50%	4,140	14,688	19,250	38,078
2	2.5	3.5	32	1100	112	50%	927	3,290	10,780	14,997
3	3.5	2	72	1100	144	50%	1,192	5,922	13,860	20,974
4	2	6	72	1100	180	50%	3,577	10,152	17,325	31,054
5	2	3.5	85	1100	128	50%	2,463	6,991	12,272	21,726
6	3.5	4	150	1100	150	50%	4,968	24,675	14,437	44,081
7	3.5	2	112	1100	168	50%	1,855	9,212	16,170	27,237
8	4	1	80	1100	160	50%	662	3,760	15,400	19,822
9	3.5	3.5	77	1100	115	50%	2,222	11,035	11,069	24,326
10	2	3.5	85	1100	128	50%	2,463	6,991	12,272	21,726
11	2	3.5	85	1100	128	50%	2,463	6,991	12,272	21,726
TOTAL							\$26,933	\$103,707	\$155,107	\$285,748
AVERAGE							\$2,448	\$9,428	\$14,101	\$25,977

* Crew size varies through the year; figure represents average during the year. Where crew size was unknown, the figure represents the crew size assumed in the 1991 Report (two).

** Where number of trips unknown, we use 85, the figure used in 1991 Report.

*** Where fishing days unknown, we assume an equal mix of one and two-day trips, yielding a total of 128 days per year (85 trips X 1.5).

ESTIMATED COSTS OF OPERATING OUT OF STAGE HARBOR:
LOW ESTIMATE

Chatham Premium:

- Market Price =	\$0.05
- Ex-Vessel Price =	\$0.025
Wage Rate =	\$3.92
Fuel Price =	\$0.92
Fuel Use (gal/hr.) =	9

							ECONOMIC COSTS			
Crew Size *	Added Steam (hours)	Fishing Trips**	Catch Per Day (lbs.)	Fishing Days***	Percent of Catch On Which Premium is Lost		ADDED FUEL COST	ADDED CREW COST	LOST CHATHAM PREMIUM	TOTAL
1	2.5	5	100	1100	200	5%	4,140	4,896	275	9,311
2	2.5	3.5	32	1100	112	5%	927	1,097	154	2,178
3	3.5	2	72	1100	144	5%	1,192	1,974	198	3,364
4	2	6	72	1100	180	5%	3,577	3,384	248	7,208
5	2	3.5	85	1100	128	5%	2,463	2,330	175	4,969
6	3.5	4	150	1100	150	5%	4,968	8,225	206	13,399
7	3.5	2	112	1100	168	5%	1,855	3,071	231	5,156
8	4	1	80	1100	160	5%	662	1,253	220	2,136
9	3.5	3.5	77	1100	115	5%	2,222	3,678	158	6,058
10	2	3.5	85	1100	128	5%	2,463	2,330	175	4,969
11	2	3.5	85	1100	128	5%	2,463	2,330	175	4,969
TOTAL							\$26,933	\$34,569	\$2,216	\$63,718
AVERAGE							\$2,448	\$3,143	\$201	\$5,793

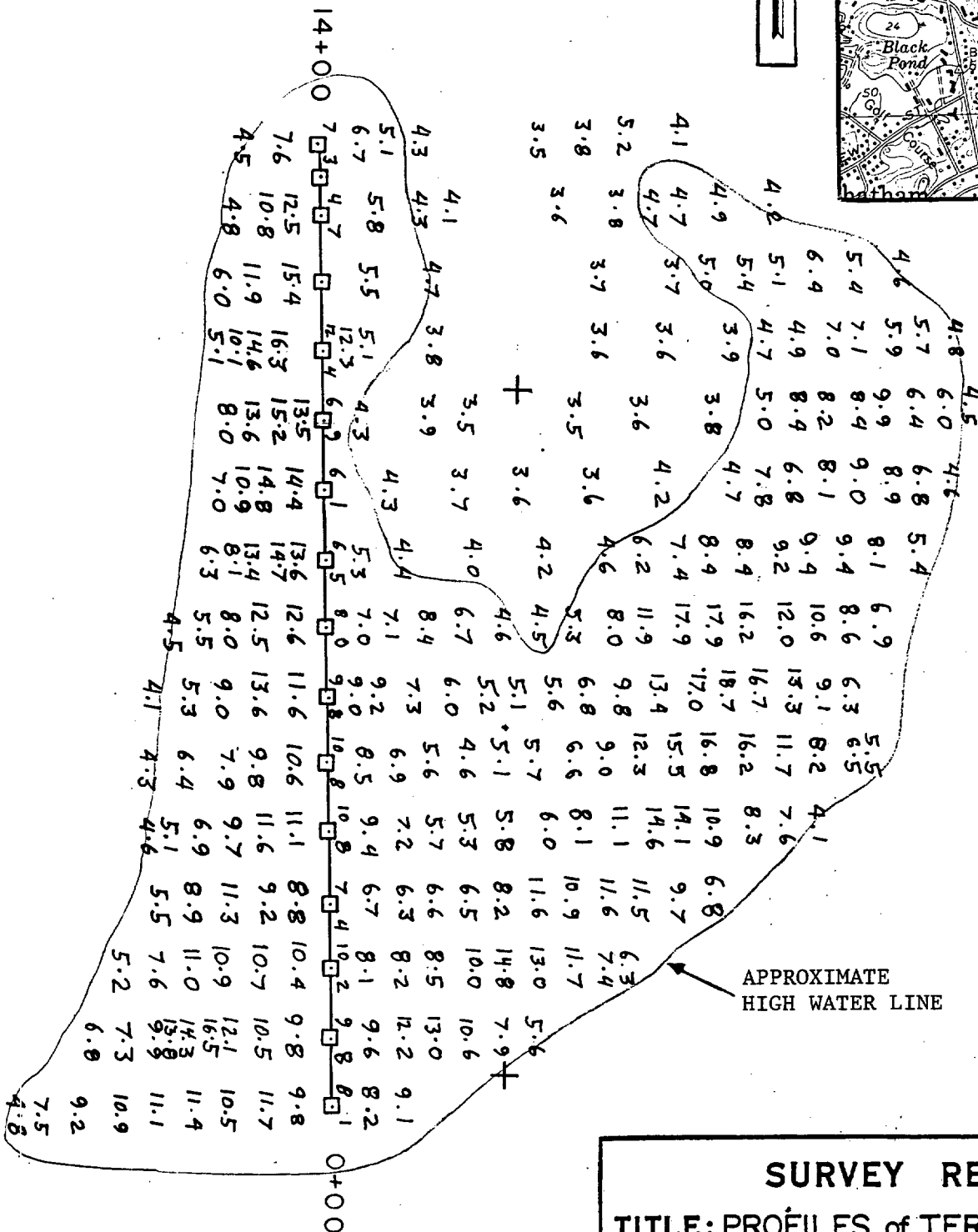
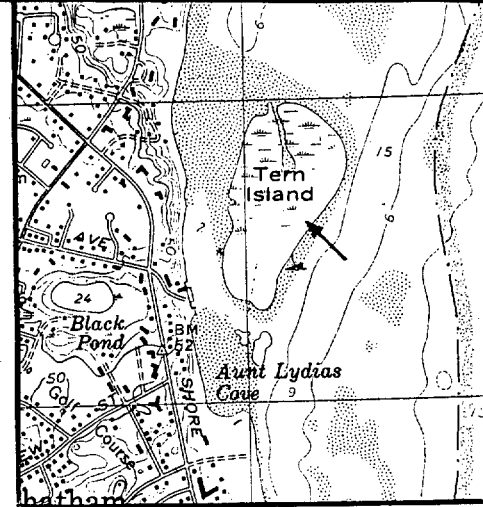
* Crew size varies through the year; figure represents average during the year. Where crew size was unknown, the figure represents the crew size assumed in the 1991 Report (two).

** Where number of trips unknown, we use 85, the figure used in 1991 Report.

*** Where fishing days unknown, we assume an equal mix of one and two-day trips, yielding a total of 128 days per year (85 trips X 1.5).

APPENDIX 4

TOPOGRAPHIC SURVEY OF TERN ISLAND



SURVEY RECORD
TITLE: PROFILES of TERN ISLAND
LOCATION: CHATHAM, MA
DATUM: M.L.W. **CONTOUR INTERVAL**
SCALE: 1" = 200' **DATE:** MARCH 1993
REF. BK. R+H4345 **PARTY:** USCE / NED
R+H4351 **SURVEY SECTION**
DWG. NO. SUR 661 **SHEET NO.** 1